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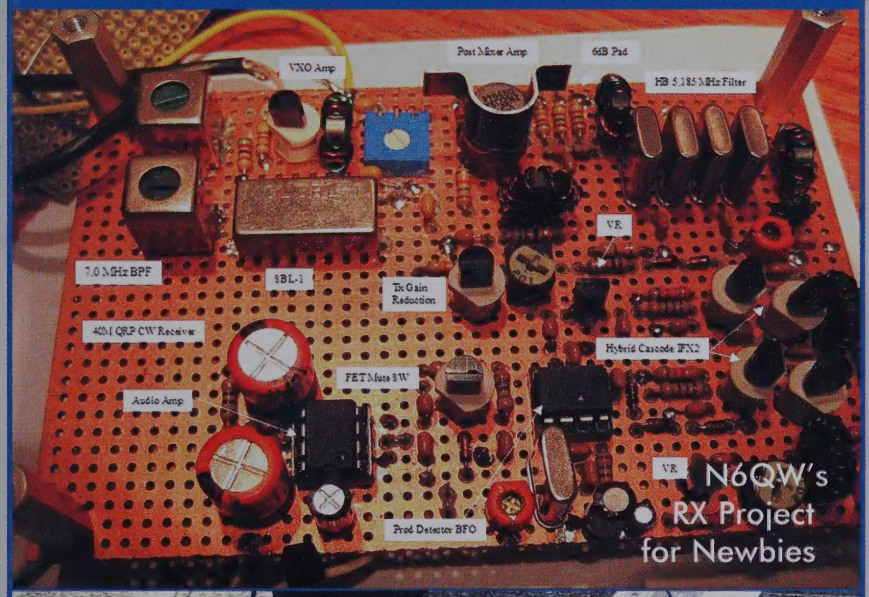
QRP Quarterly

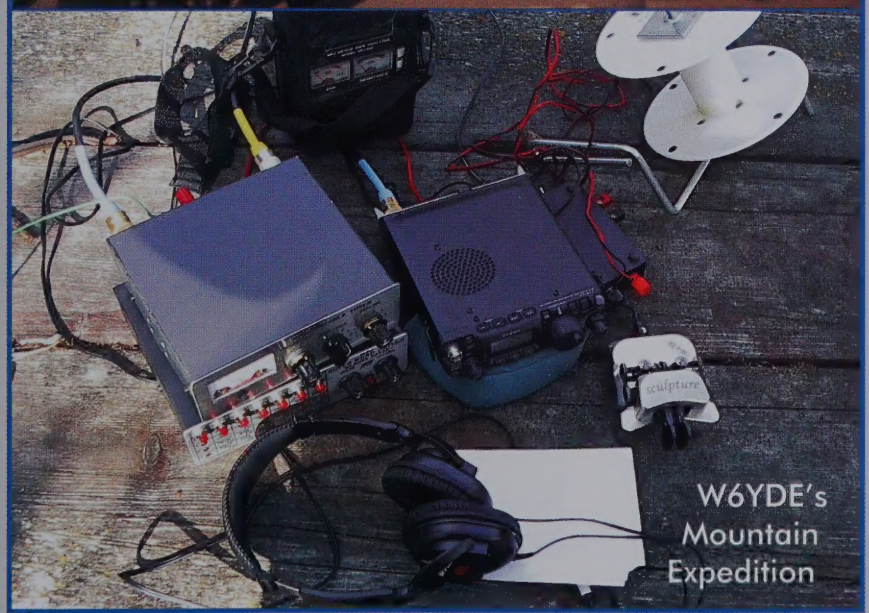
Volume 52 Number 2
Spring 2011

Journal of the QRP Amateur Radio Club International

QRP Indoors & Out



N6QW's RX Project for Newbies



W6YDE's Mountain Expedition

- K4KSR Offers Hints for Clandestine Antennas
- QRP World News—RV3GM Visits Hawaii
- WB9LPU Shows How to "QRS" Your Bug
- AE6TY Designs a Class E Amp for an SDR Rig
- Contest Results—
  - 2010 Top Band Sprint
  - 2010 Holiday Spirits HB Sprint
  - 2011 Pet Rock Celebration
  - 2011 Fireside SSB Sprint

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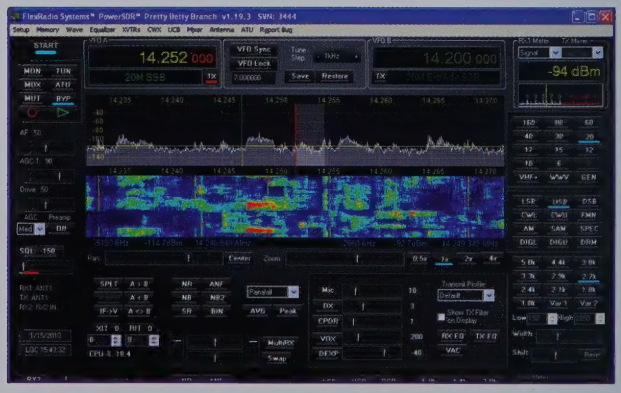

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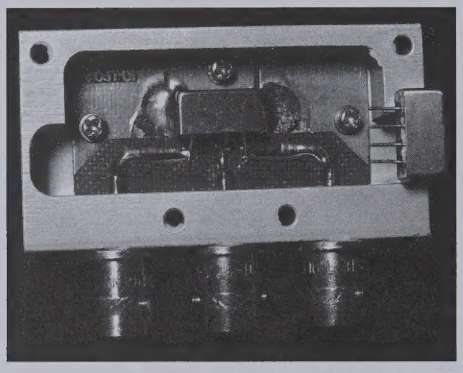

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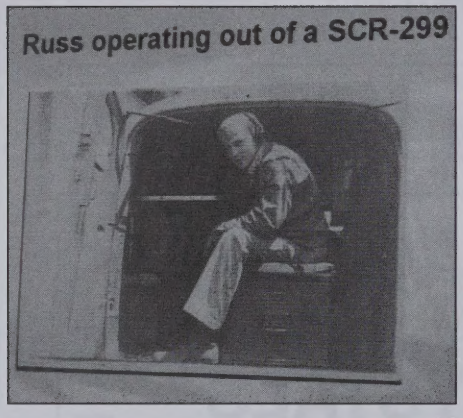

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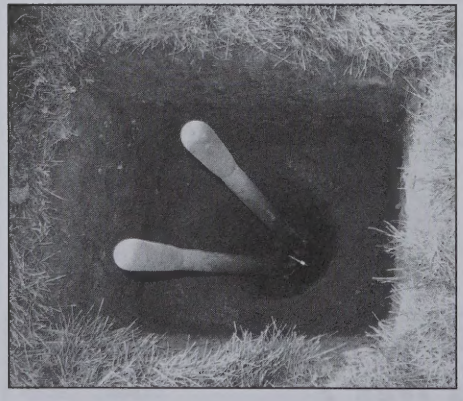

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Editor's Notes

Brian Murrey—KB9BVN editor@qrparci.org

Greetings and salutations to all fellow QRP enthusiasts out there!

As many of you know, I accepted the role of editor for the *QRP Quarterly* back in the winter of 2009. I would like to thank the entire staff of the *QQ* for helping me make the transition into this position, and frankly, without the team we have on board, this magazine would look horribly different. They deserve my praise and adoration and then some.

My main job as editor is to work with the editorial staff and our membership to collect an interesting set of articles, roughly every 90 days. Some quarters we have plenty of submissions, some quarters we work a little harder to fill the issue by deadline. Every one of you QRPers out there, have something to share, whether you know it or not. We're all interested in what you are doing with antennas, tuners, junk box projects, or even one of those crazy little ideas we all get. So please feel free to submit an article about your part of the QRP world, and if you have trouble writing it, just let us know and we can help you get it taken care of.

One last thing. My first FDIM was in 2001. I have only made it back to FDIM three times since. If you have never been to FDIM, you are missing a wonderful part of the whole QRP experience. The kit building, the vendor/club night, the symposium speakers, the really tasty banquet… and that hamfest thing they have going on at Hara Arena makes for a fun filled four days. You will meet folks that you have only QSO'd with, and rub elbows with all kinds of fellow QRPers, but best of all you will take home memories and stories that can be shared around the campfire, over and over again. If you can get there, you will not regret it.

—Brian Murrey, KB9BVN

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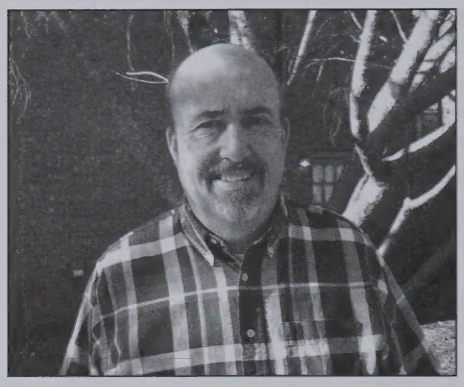
2011 FDIM Information Summary

Dates:	Thursday, May 19 through Sunday, May 22
Location:	Holiday Inn Fairborn, Fairborn, OH (Dayton area)
Registration:	Online—www.fdim.qrparci.org
Hotel:	Through QRP ARCI only—info at: www.fdim.qrparci.org
Seminar:	Thursday, May 19, 8 a.m. – 4 p.m.
Activities:	Buildathon Homebrew Contest Show & Tell Vendor Night Meet the Speakers Guest/Spouse Program Awards Banquet (with many door prizes) And of course, the Dayton Hamvention®

From the President

Ken Evans—W4DU president@qrparci.org



QRP ARCI 50th Anniversary

As I mentioned in the winter 2011 QQ, one way the club will mark the 50th anniversary is to activate the club call in all 50 states throughout 2011. This is going well and as of this writing we have had stations on from 10 states. Contacts have been made using all modes on all bands, proving QRP can be used for any mode available to the radio amateur. There are still slots open for approximately 20 states. For current news on the schedule and to find an opening for your state, see http://www.qrparci.org/content/view/8371/118/ John Burnley, NUØV has volunteered to coordinate this effort for the club. He will work with volunteers to assign a week for their state and insure that the club trustee is notified. If you wish to volunteer, send an email to John at burnleyj@gmail.com. He needs your call and location plus any weeks during 2011 that are not good for you. I hope to see all 50 states on the air during 2011. Check the web site throughout this year for other 50th Anniversary activities.

FDIM 2011

It's time to finalize your plans for the annual pilgrimage to Dayton on May 19 through May 22, 2011. The QRP ARCI "Four Days In May" is a great opportunity to meet QRPers from around the world. You may already have spoken to them on the air; you will almost certainly have met them on internet email lists.

You will learn a lot at the seminars—the noise you hear is the collective sound of 200 pennies dropping as leading experts in their field deliver fascinating presentations. There is just so much going on! Buy the latest gizmo from the guy who invented it, chat with the designer of your most recent (failed) project, or bring that project to the Show & Tell. You may even join in the CW debate in the bar! We have a line up of world class speakers signed up for the seminar and plans made for each evening.

To further celebrate our 50 years, we are asking members to bring equipment built or obtained in each of the five decades the club has existed ('60s, '70s, '80s, '90s and '00s!). We will put them on display for everyone's enjoyment. A way to see where we have been and possibly where we are going!!

Details on the event, how to register for various activities as well as hotel room booking information are at http://www.fdim.qrparci.org/. You will also find more information in this issue on registration and activities.

I hope to see you at FDIM 2011.

—Ken Evans, W4DU
President, QRP ARCI

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FDIM Seminar Presentations

Seminars: Thursday, May 18, 2011 (times are local—EDT)

0830-0930	*The Plumbing Defined Radio* Dave Cripe, NMØS
0930-1030	*Back to the Future—Another Look at the Crystal Radio* Jim Everly, K8IKE and Jay Slough, K4ZLE
1045-1145	*In My Workshop—Some ramblings of a (retired) vicar with a soldering iron* George Dobbs, G3RJV
1300-1400	*Advances in Weak Signal Communication* Joe Taylor, K1JT
1400-1500	*Introduction to Digital Signal Processing (Without the Math)* Ward Harriman, AE6TY
1500-1600	*QRP Kit Building for Youth* Chris Howard, WA4YG

FDIM 2011
Celebrating
50 years of QRP-ARCI

Thursday a full day of Seminars

Saturday Evening Awards Banquet Door Prizes

Four Days in May
May 19-22 2011
Thursday thru Sunday

Friday spend some time with vendors

- Registration and getting acquainted begins Wednesday evening.
- Seminars are most of the day Thursday, with "meet the speakers" and an open room for some casual show and tell and plenty of time to swap tales during the evening. Thursday afternoon will be the Build-A Thon (requires registration)
- Friday daytime is open to attend the Hamvention® and visit the QRP-ARCI Toy Store.
- Friday afternoon and evening activities usually include "show and tell", vendor displays and a judged home brew contest.
- Saturday is again open for the Hamvention. For the evening, and we have our great annual banquet, awards presentations and door prizes.
- Sunday is the Hamvention®, and checkout.

Thursday Evening Meet the Speakers

Friday daytime, take a break attend the Hamvention

Thursday Evening Casual Show and Tell

Wednesday evening Registration and get together

Thursday Afternoon TBD

Friday Afternoon and Evening Vendor Night Judged Competition Home Brew Displays

Saturday Morning Off to Hamvention or see the sights

FDIM Registration and Hotel Reservation

Much More! Watch the web site www.qrparci.org

Guest/Spouse Program

Home Brew Contest	Door Prizes
Build-a-thon	Discounted Hotel Rooms
Banquet	Complimentary Breakfast
Seminars	Hamvention just across town
Meet the Speakers	Nearby Restaurants
Vendor Displays	New Product Announcements
Discounted QRP Products	Spouse Program

This is preliminary information. Some changes will most definitely occur.
Please check the web site, www.qrparci.org, for the latest details and registration information.

12.14.2010

Idea Exchange

Technical Tidbits for the QRPer

Mike Czuhajewsi—WA8MCQ wa8mcq@verizon.net

In this edition of the Idea Exchange:

Beware of Bargain Hamfest Coax Jumpers (Quickie 77)—*N2CX*
Toroid Wire from Degaussing Coils—*WA4YHL*
Offset Keyer and Improved Filter for the Pixie—*W5USJ*
Cutting Circuit Board Panels—*K6GGO*
An Audio Noise Generator—*K3NHI*
Charged Capacitors in Junk Electronics—*N6NLB*
Improved Dummy Load Special Antenna—*KCØPET*
Fixing a Connectorized Mixer—*WA8MCQ*

Beware of Bargain Hamfest Coax Jumpers

In number 77 in his endless string of Technical Quickies, Joe Everhart, N2CX, cautions about putting too much trust in bargain cables—

Many of the things we constantly use in our shacks are taken for granted. Most of the time that's no problem, but sometimes when we have intermittent and unexplained problems we have to back off and carefully check even the most common items.

I reconfigured my antenna feedlines a year or so back including use of a feedthru panel of coax connectors to get the feedlines into my shack. The panel has long threaded double UHF male adapters through a board placed under a storm window. The main antenna feedline is attached to one of the adapters outside and I use a short jumper coax inside the shack.

The antenna itself is an end-fed wire with a tuner at the base of the antenna support. Since it's outside and I want to manually change configurations I have a weather-proofed patch panel with several short coax jumpers all of which are sealed to prevent water from getting into the coax.

To make a long, painful story short, all was well at the antenna itself but not inside the shack. I finally narrowed it down to the coax jumpers I was using. I'd bought a number of commercial 3 and 6 foot "RG-58" cables with BNCs at recent hamfests including Dayton. The initial finding was that the connectors were horrible! The connecting sleeve that twists onto and locks to the mating studs on the female connectors were very loose although spring loaded. Just wiggling the cables caused wild fluctuations in signal reception and, even worse, the indicated SWR jumped around drastically as well.

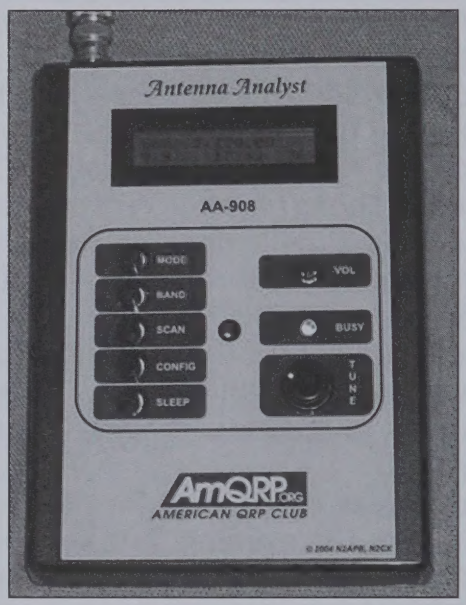

Figure 1—AA908 Antenna Analyzer.

Figure 1—AIM4170 Antenna Analyzer.

I initially suspected some BNC to UHF adapters between the cables and my window feedthru but found that they were secure. Replacing all of the "hamfest special" jumper coax cables settled down most of the receive noise and erratic SWR conditions. I still have some unaccounted for noise sources but they are much more predictable based on time of day and whether or not my neighbors are home and using consumer appliances.

Forgetting the lessons of the past and being frugal by nature (there are a number of Lelands, MacLeods and Johnstones in my ancestry), I kept using those coax jumpers in my home lab with an oscilloscope, signal generator and RF power meter. I'd convinced myself that I could just wiggle connectors if things got erratic—dumb in hindsight. I got another wakeup call when trying to evaluate some RF reflectomers (basically gadgets to read SWR) and dummy loads. I was using both my AA908 (Fig 1) and AIM4170 (Fig 2) Antenna Analyzers. I was getting results that just did not make sense. Though concentrating mainly on HF, I was trying to get accurate results up to the 2 meter band.

Now stray reactances from discrete resistors can be expected, but even at HF things were screwy. Comparing voltages from the RF signal generator using a scope, an RF voltmeter and RF power meter gave inconsistent results. Testing was bum until I swapped out the new cables for some older ones. The older cables gave much more predictable and stable results. Now what can go wrong with a simple piece of coax and a couple of connectors besides some loose connections?

The final piece of the puzzle popped into place when I was sweeping one of the loads to check its SWR bandwidth. It was a simple 51 ohm resistor in a BNC male connector. When connected directly to either the AA908 or the AIM4170 the measured resistance was very close to 50 ohms and the SWR quite close to 1:1. The AA908 is handy for manual sweeps and quick readings up to 60 MHz while the AIM gives quick graphical results up to 170 MHz. However, when I measured the load through one of the coax jumpers I got

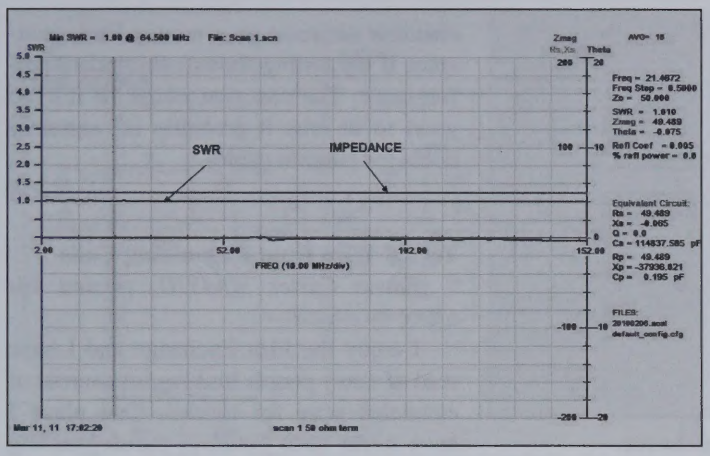

Figure 3—50 ohm direct connect.

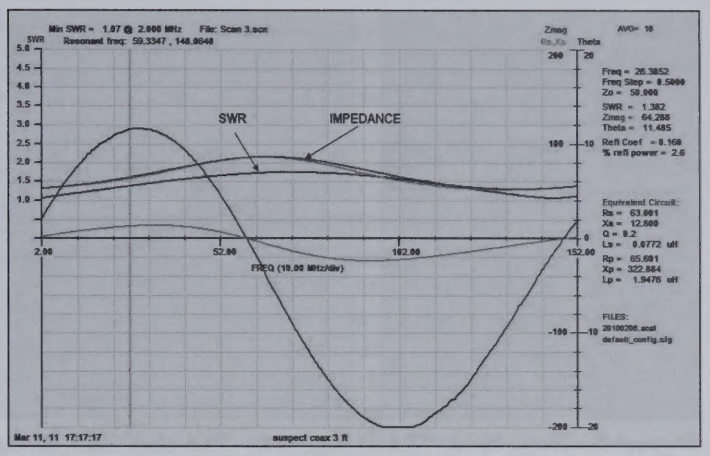

Figure 4—50 ohm suspect 3 ft. cable.

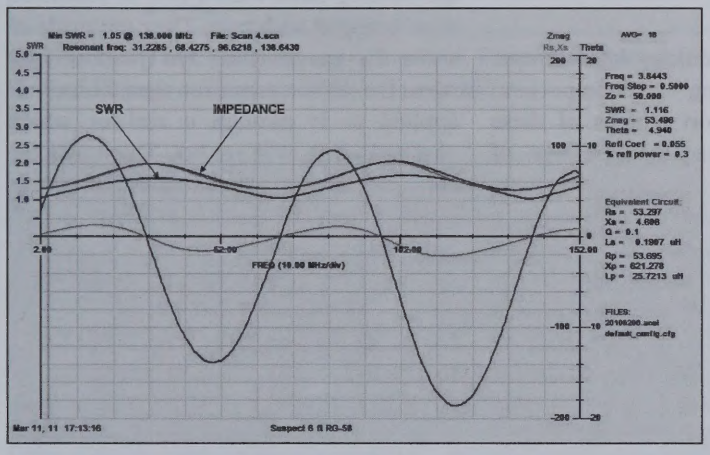

Figure5—50 ohm suspect 6 ft. cable.

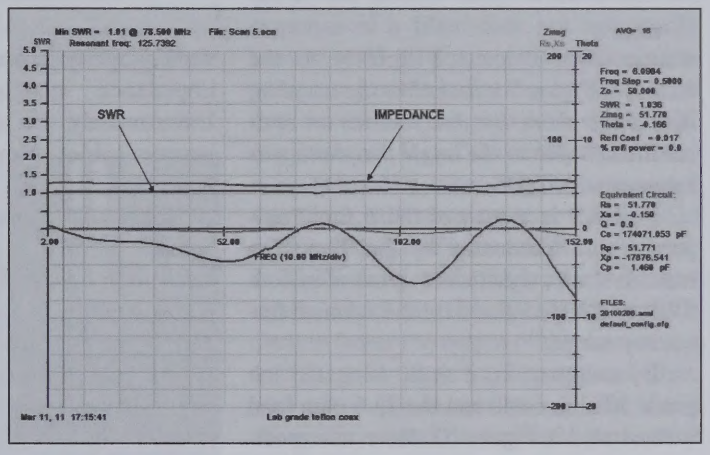

Figure 6—50 ohm lab grade cable.

SWRs that varied with frequency and went as high as almost 2:1!

To systematically investigate what was happening I backed off to using only a known calibrated load and the AIM. Figure 3 is a scan of its calibrated load connected right to its measurement connector over a range of 2 to 152 MHz. It is obvious that the SWR is extremely close to 1:1 and the impedance is 50 ohms over the entire range.

Connecting a three foot "suspect" jumper cable gives entirely different results, as is obvious in Figure 4. Here the measured SWR is near 1:1 at 2 MHz but rises to about 1.8:1 near 70 MHz, then falls back to near 1:1 at 150 MHz. The measured impedance varies from near 50 ohms to almost 90 ohms depending on frequency. This is seriously wrong for an accurate 50 ohm load in a supposed 50 ohm coaxial cable. In a system comprised of continuous 50 ohm feedline the SWR and impedance should be relatively constant over frequency.

You may note that this plot and those that follow are "busy". The plots as displayed on the associated computer are color coded and the same colors are reflected in the text readout at the right hand side but are reproduced in black and white for this article, making their interpretation difficult. The traces of most interest are impedance and SWR so they have been manually marked. For interest sake the reactance trace in most of the scans is the trace that has a low magnitude around the 0 axis and the theta or phase angle trace also winds above and below the zero axis but wings much higher and lower. One of these days I'll figure out how to remove extraneous traces from the scans.

A second "suspect" BNC equipped RG-58 cable is scanned in Figure 5. Again the SWR varies significantly over the sweep range by about 1:1 to about 1.6:1 while the measured impedance ranges from about 50 ohms up to 80 ohms.

By comparison Figure 6 shows the scan of a 6 foot lab grade 50 ohm coax cable using BNC connectors and terminated by the calibrated 50 ohm load. Here the SWR is virtually flat over the 2 to 162 MHz scan range while the impedance varies by only a few ohms. Perhaps this small variation can be explained by a combination of impedance bumps caused by multiple adapters and slight mismatch caused by a true characteristic impedance of 52 ohms vs the 50 ohm termination. The small frequency dependent variation seen will likely have very minor effects on either RF transmission or lab impedance measurements.

One hypothesis to possibly explain the noted impedance and SWR variation in the suspect cable scans is that perhaps the cable, while sold as 50 ohms and marked as RG-58, it might actually have a different characteristic impedance. To investigate this possibility a test 75 ohm load was built on a BNC male connector. On-hand resistors were used so the DC resistance was 73.6 ohms. The load is shown in Fig 7 and its scan in Figure 8 shows excellent perfor-

Figure 7—Homebrew 73.6 ohm test load.

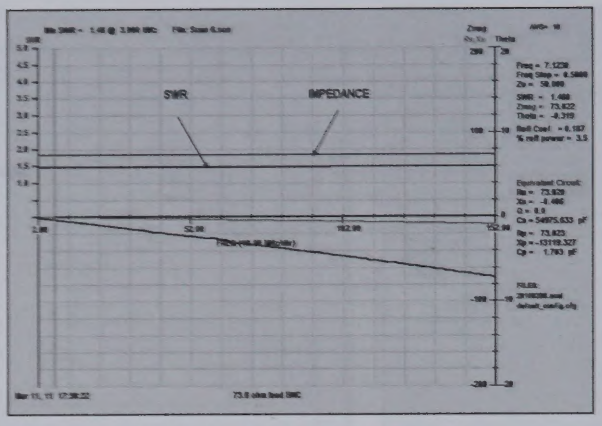

Figure 8—73.6 ohm load, direct connect.

mance when connected directly to the AIM. *[In Figure 7 it looks like the coupling ring is too short, but Joe said it's an optical illusion due to the angle the photo was taken at. —MCQ]*

Figure 9 is a scan of the 6 foot "suspect" cable terminated by the 73.6 ohm load. It shows significant variation in both SWR and impedance over the scanned frequency range.

By comparison, a scan using the lab grade 50 ohm cable and the 73.6 ohm load is illustrated in Figure 10. Here, as expected for a good, continuous transmission line, the SWR plot vs. frequency is nearly constant while the impedance varies periodically.

For casual use on HF these hamfest special coax cables may be usable for those who aren't very picky. However, for me they are something to be avoided. The erratic physical connections have caused much hair-pulling that negate their usefulness in my shack. The frequency scans seem to indicate that the coaxial cable does not have a constant impedance and will not work properly in conditions where proper impedance matching is important. Unfortunately the short lengths of these jumper cables prevent measurement of power loss.

WA8MCQ comments—I've bought a number of BNC jumper cables over the years from hamfests and eBay and always had good luck. However, they have always been Pomona cables, a manufacturer of known quality, and in the original sealed bags. They do fetch a bit of a premium, but it's worth it. I asked Joe to clarify what he meant by "hamfest special" and he responded with this—

What I mean by "hamfest special" coax cables is those without a brand name at a cost well below the cost of connectors and good cable. As I recall the cables I bought were about $2 for the 3 footers and $3 for the six foot versions. They looked new and had wraps tying them into bundles. Pomona and other cable manufacturers have similar appearance but higher cost. From now on I will generally build my own cables, buy only brand name merchandise or insist on a money back guarantee if my testing shows substandard performance. The common adage "if it's too good to be true it probably is" certainly holds for bargain cables.

—de N2CX

Toroid Wire from Degaussing Coils

Edwin Carter, WA4YHL, passed this along by e-mail—

I enjoy the Idea Exchange and I have read of many people looking for sources of enameled wire for toroids. One place I have never seen listed is the degaussing coils on old CRT TVs and monitors. They are nothing more than a coil of enameled wire wrapped with tape. They are made of about 28 gauge wire. The purpose was when the set was turned on the coil had AC applied to it through a resister which changed value as it got hot. This made the coil an electromagnet to get rid of any stray magnetism that could cause distortion on color sets.

—de WA4YHL

Offset Keyer and Improved Filter for the Pixie

Chuck Carpenter, W5USJ, sent these mods for the popular Pixie minimalist transceiver by e-mail—

I got an urge to work on my now almost ancient Tiny Tornado version of the Pixie from KA8MAV. It seemed like there was a better way to do the frequency offset between transmit and receive. The method Steve Weber, KD1JV, used in the DCXXB transceivers looked like it would work with the TT Pixie. And it did. The circuit on the left in Figure 11 did the job.

To set the offset, I measure the frequency key down. The FET is switched to ground across the trimmer connected to the

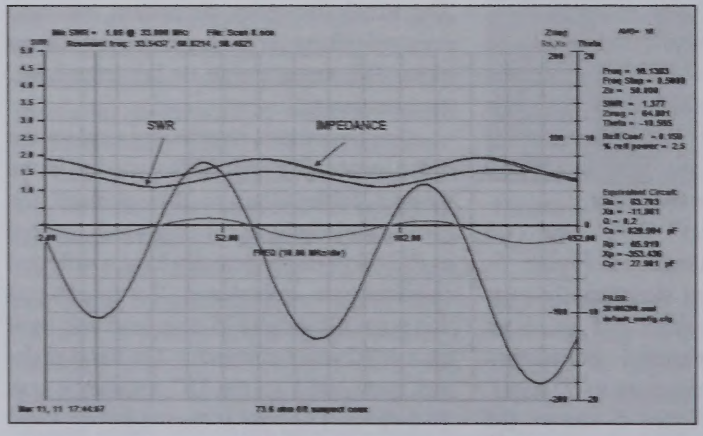

Figure 9—73.6 ohm load with 6 ft. suspect cable.

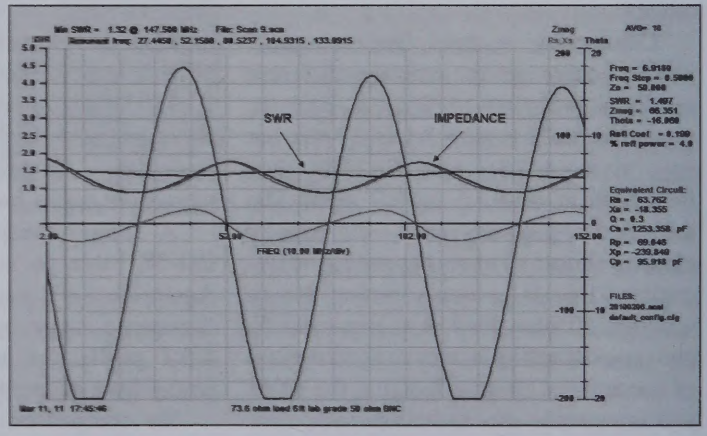

Figure 10—73.6 ohm load and lab grade cable.

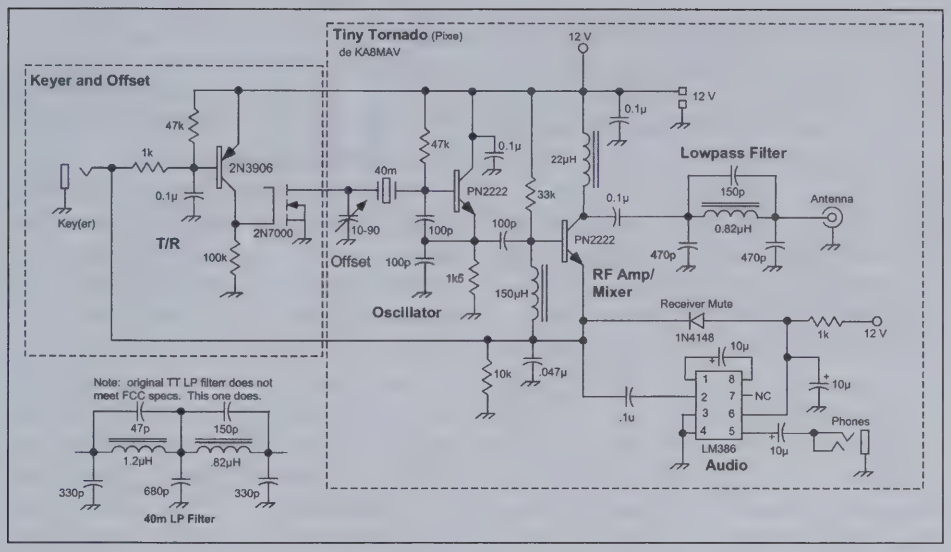

Figure 11—Tiny Tornado version of the Pixie with added frequency offset circuit (left) and improved output filter (lower left).

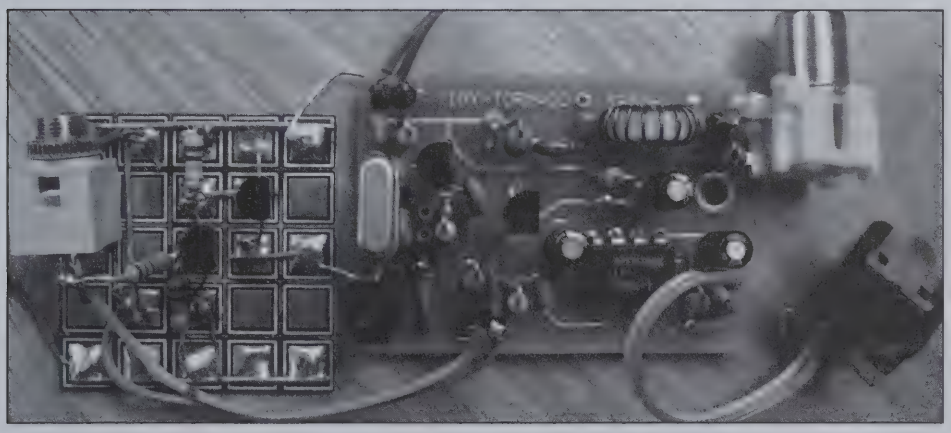

Figure 12—Added circuit at left, built on MeSquares board.

crystal. Then key up, the trimmer is adjusted for the desired 600 to 800 Hz offset. Neat.

Figure 12 shows the unit. The "Manhattan" board used for the offset keyer circuit is a section of MeSquares, available from Rex Harper, W1REX of QRPMe [Maine] fame.

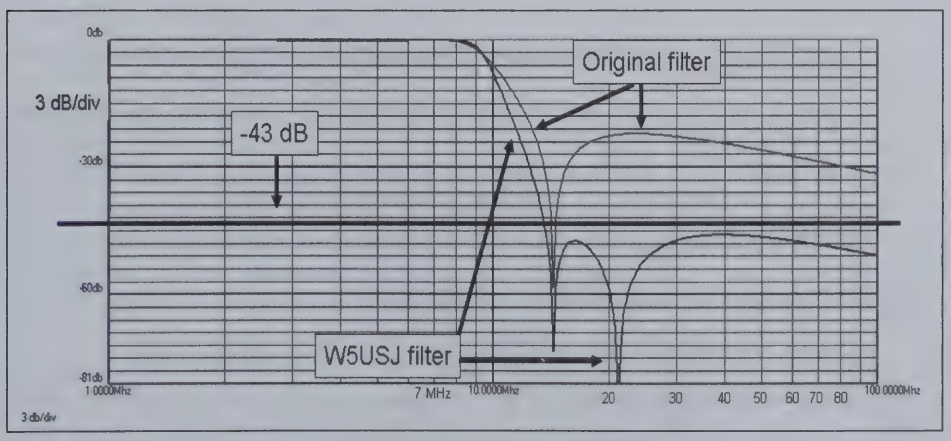

Figure 13—Plotted response of the stock filter and W5USJ upgrade; both are for 40 meters. The second harmonic is down 60 and 75 dB respectively, yet overall the stock filter probably does not allow the rig to meet FCC specs.

The original output filter in the TT does not meet FCC specs. The one in the lower left of the schematic does.

—de W5USJ

WA8MCQ notes—The URL for the various QRPMe kits is www.qrpme.com. W1REX has quite a variety, and also sponsors the annual Lobstercon QRP event in Maine. The MeSquares is actually a board of snap-apart Manhattan pads but obviously can also be used as a prototyping board.

I drew up both filter circuits in the free software from AADE (www.aade.com) and ran the analysis on them. Figure 13 shows the results. Keep in mind that the response of a filter does not necessarily have to be 43 dB down at the harmonic frequencies; just the harmonic itself has to be that far below the signal to meet FCC requirements. But if the strongest harmonic isn't terribly weaker than the main signal the filter will have to have fairly good attenuation. The response of the stock filter is 22 dB down at 21 MHz, the third harmonic, which most likely will not be sufficient to lower the output of this transmitter to at least 43 dB down. The updated filter, with a response better than –43 dBc at and above the second harmonic, is guaranteed to meet the spec.

Unfortunately I don't have a Pixie to check on a spectrum analyzer, but I did find a photo I took years ago of the spectrum of an unnamed 5 watt QRP kit. Like the Pixie, it had a class C amplifier so this will give some idea of how strong the unfiltered harmonics can be. (This was from my column in October 1994; I took pains to not mention what the rig was so people wouldn't get the wrong idea. It was

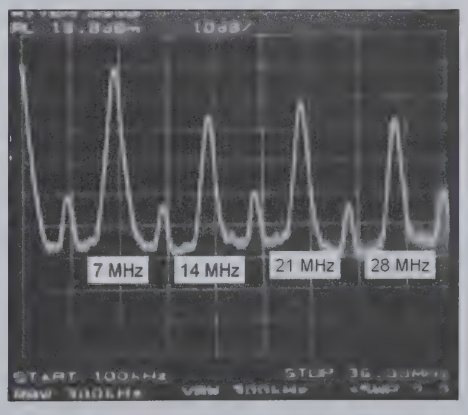

Figure 14—Spectrum analyzer display of an anonymous 40 meter 5 watt kit with output filter disconnected from the class C amplifier. (Vertical scale 10 dB/div.)

not a criticism of that kit, just a fact of life of class C amplifiers.)

The photo in Figure 14 is the output of the 7 MHz rig with the output filter disconnected. (The spike at the far left is the infamous spectrum analyzer "zero MHz spur". According to me in 1994, the weak spurs are related to the TX IF frequency.) The second harmonic is about 15 dB down, the third about 11 dB, and the fourth is 17 dB below the carrier. If this rig had the stock Pixie filter on it, at the second harmonic the attenuation of 60 dB would put the signal an impressive 75 dB below the carrier. However, at the third harmonic where the filter attenuation is only a bit over 22 dB, the filtered output would be 33 dB down, falling far short of the current FCC limit.

—de WA8MCQ

Cutting Circuit Board Panels

This was posted by Bob Fish, K6GGO, to the "spectrumanalyzer" discussion forum on Yahoo.com. It is a product-specific group, related to building and using a particular homebrew spectrum analyzer design (not the W7ZOI one, by the way). Although his specific application is cutting out individual small circuit boards from multi-up panels, it's still basically cutting PCB stock, something a lot of us do to make boards, enclosures, etc. Here's the way he does it—

I've cut a lot of boards up in the last few months. I started by using a hack saw blade, but before long I realized that it took way too long and it was way too hard to be accurate. The cut would wander one way or the other and it didn't take long before you were dangerously close to the copper.

I tried a jig saw, a scroll saw and a Dremel tool with a cutting wheel attached. The scroll saw was probably the best of this bunch, but still not great results. The way I ended up cutting 99% of the boards I prepared for shipment was as follows:

I placed the panel of boards on my work bench. I then clamped a metal straight edge along the intended cut line and C-clamped the straight edge in place on top of the boards and to the bench. I then scored the boards along the straight edge 6 or 7 times with a very sharp (brand new blade) utility knife.

I then turn the panel over and do the same thing on the other side of the board on the same cut line. A word of caution here, make sure you use a THICK straight edge, at least 1/16th inch thick. I used the ruler part out of my combination square. You don't want that knife blade to jump up over the straight edge and take off a couple of fingertips.

Another tip [if you are cutting individual boards out of a panel], center the knife blade between the copper traces of adjacent boards first, then slide the straight edge against the knife blade, then clamp it. If you center the straight edge first, your cut will not be centered. It will be offset by the thickness of the cut (it will be slightly wider than the blade because of the fibrous nature of the material). Trust me, it makes a difference on some of the cuts that have adjacent boards very close together.

After the board is scored 6 or 7 times top and bottom along the cut line, I placed it in my Super Duper Harbor Freight bending brake, clamped it along the cut line, lifted the handles, and it snaps the board right along the line. A couple of passes with some coarse sand paper (for flatness, place the sand paper on the bench top and draw the board across it) and you're good to go.

If you don't have a bending brake, you could probably get away with clamping the board to the bench top under a piece of plywood or something and lifting with your thumbs. I didn't try this, but I suspect it would be OK. A bending brake is perfect because it focuses all the force on the cut line.

Here is the URL for the exact brake I bought. I originally bought it to make electronic enclosures out of sheet aluminum, but I haven't made any yet. I've sure cut up a lot of boards with it though.

http://www.harborfreight.com/30-inch-bending-brake-67240.html

The best part of this method is that there is very little dust. All the saws and the Dremel tool method produced dust clouds. Breathing fiberglass dust is not good for you. I kept a shop vac with a HEPA filter handy for clean up because of the large number of boards I cut. Fiberglass dulls knife blades very quickly. It may take you several to do one set of boards.

Sorry for the long post but I thought someone might find it helpful. Of course, use this method at your own risk. That utility knife can do a lot of damage if you're not extremely careful!

—de K6GGO

An Audio Noise Generator

Bob Kopski, K3NHI, made a post to the EMRFD discussion group on Yahoo.com about a recent project and gave directions on where to find it in the Files section of the EMRFD home page. The following is adapted from that—

I have been working on a homebrew audio spectrum noise source for use in conjunction with Spectrogram with an interest in examining various filter bandpass characteristics. *[Spectrogram is an audio frequency spectrum analyzer program that runs on a personal computer which has a sound card. —WA8MCQ]* I began with the usual approach of using a zener diode as a noise source followed by a limited bandwidth gain block to get the output up to a useful level. Before building a self contained battery powered, metal boxed instrument I first checked out the basics using a plug-in type breadboard. A few quick observations gave me a gain target for the amplifier which was easy to realize using a simple cascade of op amp stages.

I had an assortment of zeners in the junk box to try but I also included some reverse biased transistor EB junctions. I wanted to bias these in the "low milliAmp area"—battery power, ya know! What I got was a blizzard of varied noise data at the amplifier output—the levels were "all over the place". My experimental results are tabulated in Figure 15.

The noise voltage values listed are as measured with an HP 3400A True RMS voltmeter at the amplifier output. This temporary test amplifier version had one dominant R-C rolloff of about 5 kHz BW and approx. 76 dB gain. Each sample diode was biased at four levels from 0.5 to 5.0 mA—just to see what would happen. I should note that the 1N52xx diodes were all of the same manufacturer and I don't know if other brands would display different performance.

Some trends stand out. First, it's clear the EB junctions categorically had a lot more and widely variable noise to offer than the "real" zeners. Next, in general, higher bias currents in the range tested have an associated lower noise. But, there are some cases where the observed noise

Sample	Part ID	Nominal voltage	Relative true RMS millivolts noise, 5 kHz bandwidth, with various bias values 0.5 mA	1 mA	2 mA	5 mA
1	short		7.8	N/A	N/A	N/A
2	1N5231B	5.1	17.5	16	14.5	11.5
3	1N5232B	5.6	21	17.5	14	11
4	1N5234B	6.2	48	28	18	12.5
5	1N5235B	6.8	68	42	28.5	17.5
6	1N4733	5.1	17.5	16.5	15	12.5
7	1N4735	6.2	63	34	21	15.5
8	2N3904_1	7.33	480	280	90	50
9	2N3904_2	9.55	2800	1800	72	470
10	2N3904_3	7.79	315	250	220	205
11	2N3904_4	7.93	1000	580	190	165
12	2N3904_5	8.2	1800	1050	420	66
13	PN2907	11.92	1300	720	530	170
14	2N3906_1	7.73	710	380	240	150
15	2N3906_2	8.02	600	330	240	155
16	PN2222	8.82	330	180	105	135

Notes: Test amplifier gain ~76 dB; transistor connections are E-B diode only.

Figure 15—Comparison of the noise outputs of various diodes and transistor emitter/base junctions.

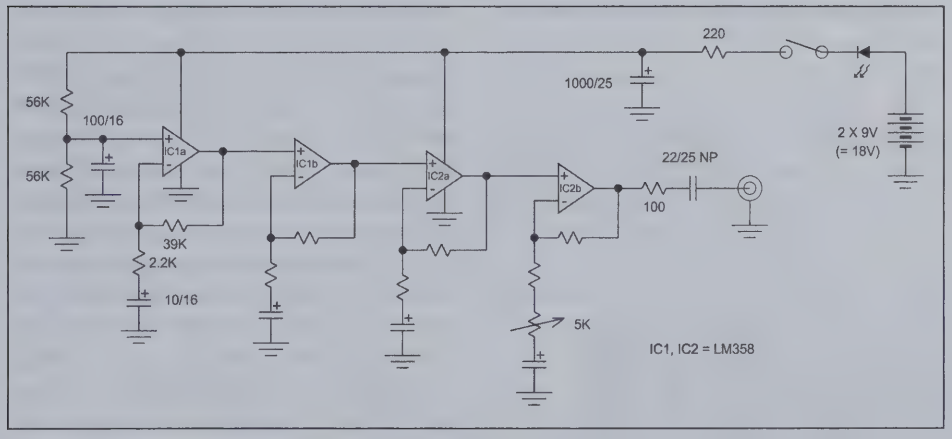

Figure 16—A zener-less audio noise generator.

Brand	Sample 1 volts	Sample 1 relative dB	Sample 2 volts	Sample 2 relative dB
National	0.76	–0.2	0.76	–0.2
ST	1	2.2	0.98	2
Fairchild	0.77	–0.1	0.76	–0.2
ON	0.72	–0.6	0.72	–0.6
TI	0.69	–1	0.68	–1.1
Diodes Inc.	0.45	–4.8	0.45	–4.8

Note: for experimental convenience "relative dB" is HP 3400A reading relative to 0 dB on the 1.0 volt scale. Amplifier gain is ~102 dB; amplifier 3 dB BW >20 kHz.

Figure 17—Noise output with various LM358 op amp chips.

rose on each side of a minima as the current was varied. (That's right—those numbers are NOT typos!) Also in general, the higher the zener voltage, the higher the noise.

Unlike the zener diode case, I did have some varied manufacturer/lots of the same 2Nxxxx numbered transistors to try—and you can see the results are highly variable for the same 2N number. Overall one might conclude the EB diode connection is not so good for this purpose for more than one reason.

Thinking that I might find more predictable and more uniform results by avoiding the zener-based approach, I tried using just a terminated, higher gain amplifier as the noise source. This amplifier cascade consists of two dual op amps or four amplifier sections total and has an overall small signal 3 dB bandwidth of >20 kHz. The schematic is shown in Figure 16. Noise measurement results for two samples each of six different brands of the common LM358 part are shown in Figure 17.

At this point I'd had about enough experimenting and decided to stay with the zener-less approach. I built up a self contained version with battery power in a minibox—all this to keep any threat of hum intrusion at bay (see Figure 18). Since I was trying to make noise, I chose to use the loudest '358—those made by ST—although any of the samples would have been fine.

Figure 19 is the resulting Spectrogram plot at the widest available bandwidth from that program. So, now I have a loud, audio range, nicely flat, noise source—all ready for some candidate filter designs that need testing, because "to measure is to know"!

Bob later posted this update to the EMRFD forum—

In my recent posting I noted that at that time I had not yet applied my new noise source. Since then I have built the filter circuit of Fig. 3.50 in *Experimental Methods in Radio Frequency Design* as a test case. (This filter is presented as an SSB candidate.) I then exercised this filter three ways including a manual test, Figure 20, with the noise source, Figure 21, and with an experimental audio sweep source/detector combo, Figure 22. [The detector uses an AD8307 logarithmic power detector chip.] You can compare what I got with EMRFD Fig. 3.51.

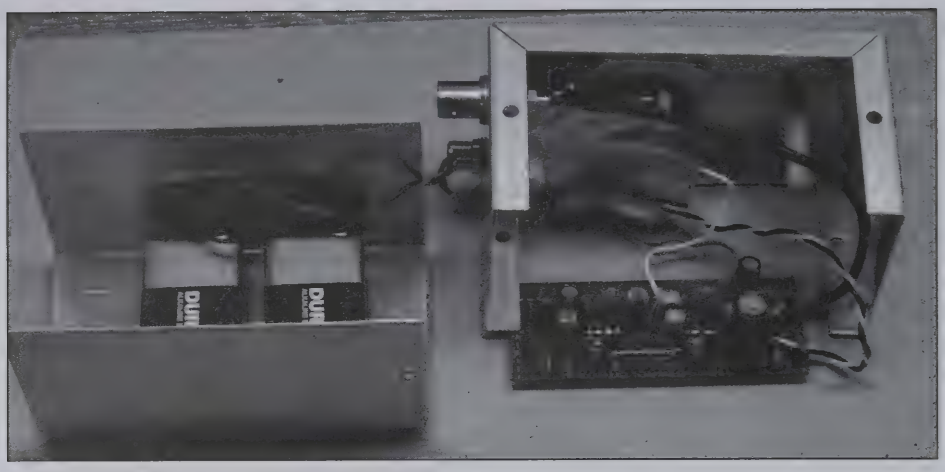

Figure 18—The completed noise generator.

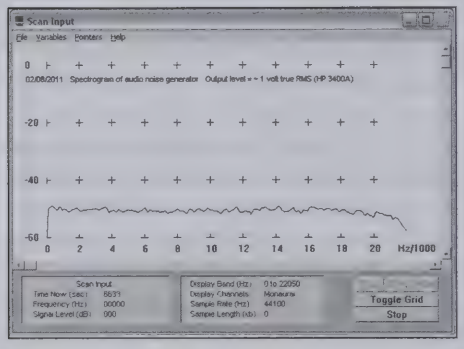
Scan Input
File Variables Pointers Help
02/08/2011 Spectrogram of audio noise generator Output level = ~1 volt true RMS (HP 3400A)
Hz/1000
Toggle Grid
Stop

Figure 19—Noise output of generator plotted with Spectrogram.

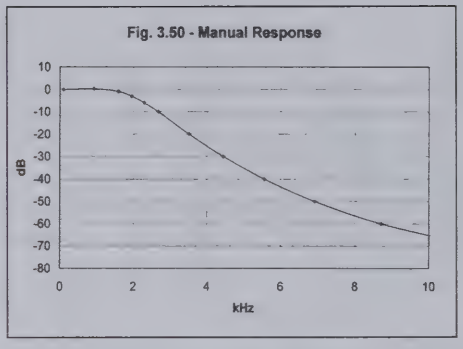

Figure 20—Filter from EMRFD evaluated manually.

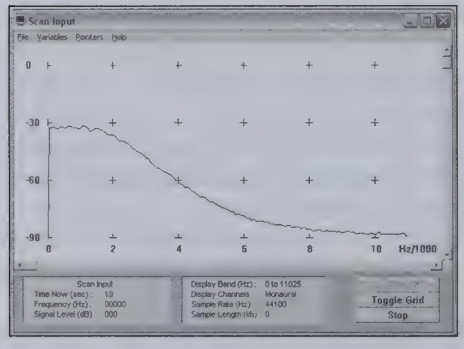

Figure 21—Filter evaluated with the noise source.

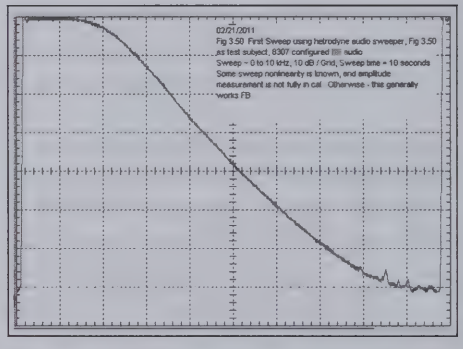
02/21/2011
Fig 3.50 First Sweep using hetrodyne audio sweeper, Fig 3.50
as test subject, 8307 configured audio
Sweep ~ 0 to 10 khz, 10 dB / Grid, Sweep time = 10 seconds
Some sweep nonlinearity is known, and amplitude
measurement is not fully in cal. Otherwise - this generally
works FB

Figure 22—Filter evaluated with audio sweep source and AD8307 based detector.

It's fair to note here that I built the filter circuit with parts on hand (not selected) so some departure from the published response is not unreasonable. Also, the experimental audio sweeper/detector combo is somewhat deficient in frequency linearity and output calibration respectively—but even so the comparative results are not too shabby, I feel.

At this point I feel Spectrogram gives a reasonable overview result but lacks the "fine grain" available with a point by point plot—or better yet, sweep—of a circuit frequency response. In any case this has been a fun pursuit!

—de K3NHI

Charged Capacitors in Junk Electronics

Here's a bit of a cautionary tale for those who like to salvage parts out of junk electronic devices. Although probably pretty rare, don't forget that some could possibly have capacitors with some charge remaining in them. Although most things use fairly low voltages there are still lots of devices that may have power supplies with double digit volts. And even when the voltages aren't terribly high there could still be a hefty charge lurking.

Lane Cox, N6NLB, posted this story to the EMRFD discussion forum on Yahoo.com as an aside to some other topic—

"I went to Walgreen's [a large drug store chain] to pick up some throw-away, single use cameras, because I wanted some of the high voltage electrolytic caps that are in them. When I was opening up one of the cameras, I got a small shock!! Not enough to hurt me but it did get my attention. After that I was careful to use a 30k resistor to discharge all the caps."

—de N6NLB

Admittedly the throw-away cameras are a bit of an extreme example since they have to charge up a cap enough to fire a flash bulb. Most things will have far lower voltage, but don't forget, anything electronic can have some charge left in it, and it won't necessarily discharge fully when power is turned off. (Example—a regulator or pass transistor in the power section opens up, the device goes in the trash and the filter capacitors stay charged since there is nowhere for the electrons to go.)

And even if voltages are low enough that you wouldn't normally feel them even with a fully charged capacitor, there can still be a nasty discharge, possibly high current, if inadvertently shorted by a ring, screwdriver, pliers, etc., during disassembly. That could damage a tool or capacitor, and possibly a finger.

It's never a bad idea to short all of the capacitors first before taking something apart or working on it. To avoid possible damage to the caps by a direct short it wouldn't be a bad idea to make up a simple discharge tool, perhaps consisting of a couple of scrap meter probes soldered onto a 100 ohm, 10 watt power resistor available from Radio Shack.

Improved Dummy Load Special Antenna

The Summer 2008 edition of the Idea Exchange described a dummy load antenna that was used for a Dummy Load QSO

Party held in the motel rooms at the OzarkCon 2007 QRP gathering, a very localized on-air event. This year, Rick Bennett, KCØPET, told about his version of the antenna on the 4SQRP online discussion forum and his web page—

The credit for the original idea goes to Terry Fletcher, WAØITP, for the OzarkCon Dummy Load Special. This could be called a "resonant" version of the dummy load special. I had the need to construct some dummy load antennas for training purposes, so this is the product of some trial and error starting from Terry's original idea. The problem I encountered is that the original design, if made with much length of wire, becomes inductive and the transmitter sees a high SWR. Not a problem with an antenna tuner, but I decided to try making one that would not require a tuner.

This improvement "tunes out" the inductance by using a length of speaker wire or zip cord as a long capacitor. To make the zip cord into a capacitor, connect one conductor of the zip cord to the rig and the other conductor to the load (if you want to check it with a meter, you will have no DC continuity between the rig and the load). The 50 ohm resistor in the middle can be any combination of resistors that makes about 50 ohms. I used a single 5 watt, 51 ohm power resistor. Figure 23 shows the details.

Although I came up with the dimensions here using some #24 speaker wire I had on hand, I recommend you start with the full length of unzipped cord and trim it back to resonance using an antenna analyzer. I doubt that all zip cord and speaker wire are created equal when it comes to capacitance per foot. Also, this design could be used for other bands by adjusting the lengths.

Of course the purpose of this antenna is for such things as "Dummy Load QSO Parties", training, testing etc. Since this is effectively a radiating dummy load, do not expect your signal to radiate much past your front yard.

—de KCØPET

Fixing a Connectorized Mixer

A number of companies make connectorized mixers in small enclosures, usually with BNC or SMA jacks. They are handy for experimenting on the bench, and sometimes appear on eBay, at hamfests, etc. Prices for new ones are more than I'd like to pay, such as the model shown here which is currently available and costs over $60 new. They can still be relatively pricey even on the used market although occasional bargains do pop up.

While exploring eBay listings for BNC mixers I started seriously considering a unit by another manufacturer listed for $19.95. But then farther down I found a pair of listings for the Mini Circuits model ZP-10514, shown in Figure 24. They were being sold as untested, but at a $10 buy-it-now price for each I couldn't resist and jumped on them. I reasoned that if even one worked I'd be ahead of the game since I could repair the other easily.

Testing showed that one was in fact dead. Fortunately I have a variety of Mini Circuits mixers accumulated over the years from hamfests and eBay and knew I'd be able to make it work somehow. After removing the screws the lid had to be pried off; it appeared to have been sealed with a thin layer of RTV sealant ("room temperature vulcanizing"). Figure 25 shows what's inside, along with my repair part sitting on the right edge. I was pleasantly surprised to see that the unit was not potted with a big glob of RTV as were some Mini Circuits packages I've opened, making repair a lot easier.

Even better, the mixer inside was a packaged unit, not made from discrete components, and in the same package as the TUF and TFM series mixers. I happened to have a few TFM-2 mixers left

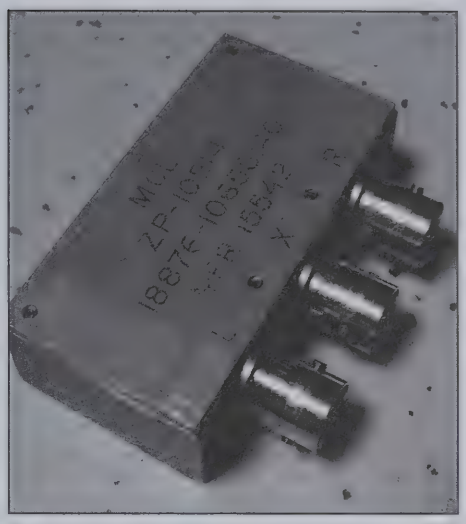

Figure 24—A vintage connectorized mixer.

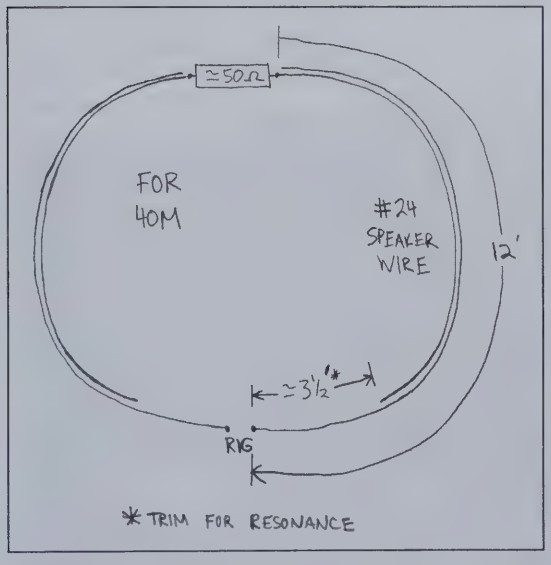

Figure 23—The improved "dummy load" antenna.

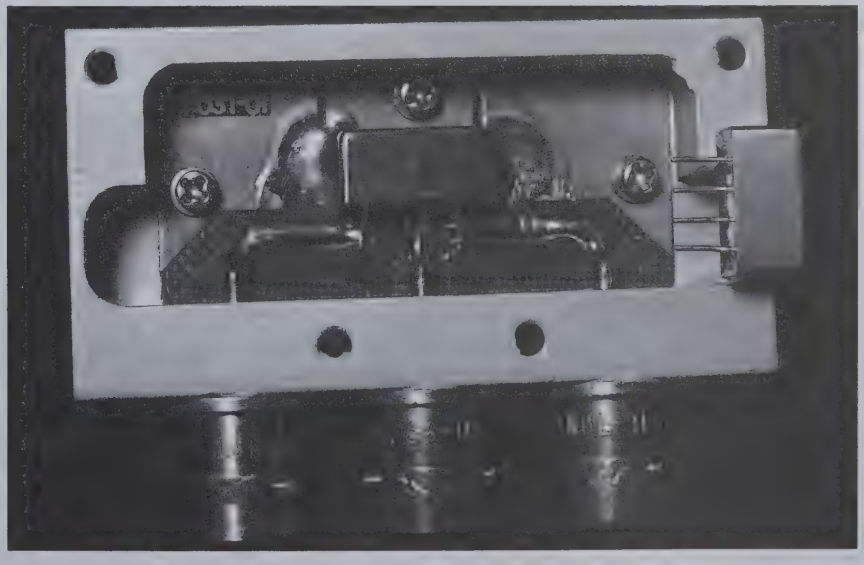

Figure 25—The mixer is easy to work on and a replacement module was available (right).

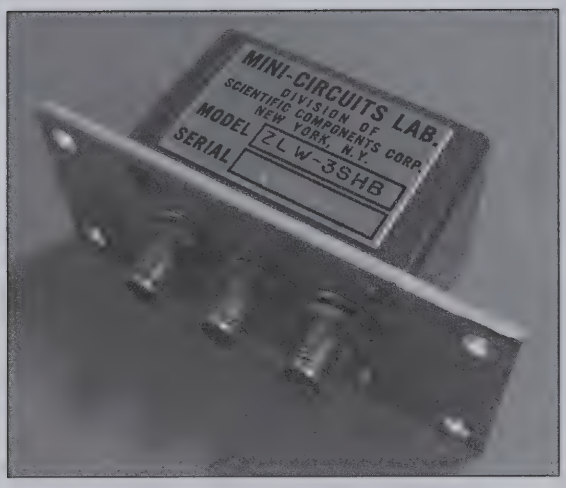

Figure 26—Another style of connectorized mixer,with optional mounting bracket.

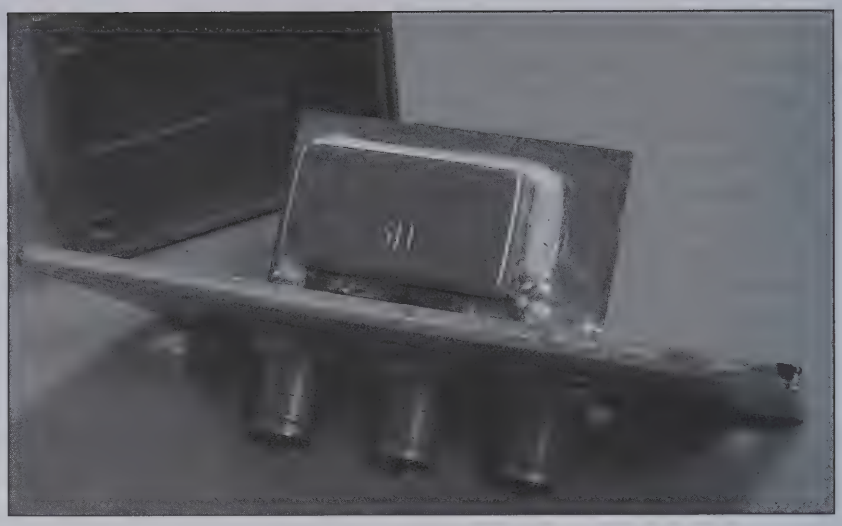

Figure 27—Another wide open, easy to repair unit.

over from a surplus batch NØOCT bought for me years ago and it went in easily. (If I had had to repair it with something in a larger package it might not have been possible to get the cover back on, but even that would have been perfectly acceptable for bench use.)

The model number is ZP-10514, the original mixer inside was marked as TFM-10514, and I presume it's essentially a clone of the old HP 10514 mixer. (You can still see those on eBay from time to time.) The frequency specs are identical, 0.2 to 500 MHz. Like both of those, the TFM-2 I put inside is a Level 7 mixer (+7 dBm LO drive). The frequency range is different, 1-1000 MHz, so I'll put a note on the outside.

Figure 26 shows another of my mixers, the ZLW-3. (The suffixes indicate that it's high level LO drive, +17 dBm, and has a mounting bracket.) Figure 27 shows the inside, which has a TAK-3H mixer. (Unlike the other one, the cover wasn't sealed with RTV and came off easily.) The package is essentially a low profile version of the one the SBL-1 comes in. Since I don't really need a +17 dBm mixer on the bench and the frequency range is relatively limited due to the TAK-3H, I'll probably replace it with an SBL-1. Although a somewhat taller package, there is still plenty of room for it to fit. (Those who share my obsession with Pomona boxes have probably already noticed that that's what Mini Circuits used for this model.)

If you come across a connectorized mixer that's known to be bad, you can probably get it for an extremely low price and then swap out the mixer module inside and have a great bench accessory. (And even if it does have discrete components instead of a module you still might be able to squeeze one in.)

—de WA8MCQ

The Fine Print

You know the drill--send your info to Severn any way you can get it here (e-mail, snail mail, floppy, CD, handwritten on a napkin, etc), or tell me where you found something of interest on the Internet. We take care of the rest, editing, redrawing, etc. The readers are waiting!

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QRP ARCI Contests are FUN!

Mark ur Calendars

10 July 2011	**Summer Homebrew Sprint**
27 August 2011	**Welcome to QRP**
10 to 12 September 2011	**End of Summer VHF Contest**
15 & 16 October 2011	**Fall QSO Party**

QRP Clubhouse

Tim Stabler—WB9NLZ wb9nlz@yahoo.com

I must start this column off by telling you that my basement "man-cave" (11 × 25 ft. room) construction is going well and should be finished soon. I say this as my radio activity has been limited due to the snow (including plenty of "lake effect" snow) in northwest Indiana, so operating has been at a minimum. When the room is done, everything will be set up again.

Minnesota QRP Society (MNQRP)

It has been an exciting time to be involved with the Minnesota QRP Society over the past few months. The focus of the club continues to be on technology that furthers their love of amateur radio.

Each month the club has presentations and discussions on many technical subjects related to amateur radio. Recently they enjoyed some great presentations by many esteemed members of the club such as:

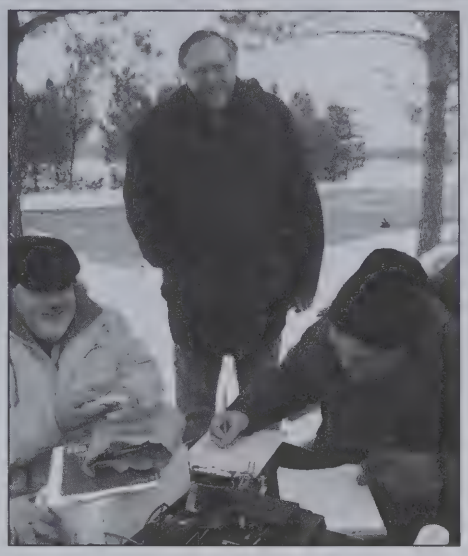
Steve, NWØC, gave a presentations on Flash drives, plus another one on "Switch Mode Power Supplies—Frequency Regulation"

Craig, AAØZZ, gave a presentation on the Si598 Signal Generator in an Amateur Radio Transceiver.

Orcy, WØQT, gave a presentation on the ease of operating PSK31. She has given this presentation to a few other clubs as well.

Ron, KØTC, Steve, NWØC, and Dave, WØRU, presented photos of their stations, antennae, workbenches, etc.

Russ, WØNBU, showed us his progress in learning PICAXE with help from Mert, WØUFO.



Members of the Minnesota QRP Society are definitely not afraid of a little snow and cold for FYBO!

The group also continues to be a QRP operating club recently participating in the annual FYBO event. And since many were inspired by Orcy's (WØQT) presentation on operating PSK31, they held a concurrent build-a-thon for anyone that wanted to build a PSK meter to assist with their operation. Everyone had a great time, and one member even commented that it was one of the most fun days they have had in ham radio. Pictured are a few pictures of FYBO and the build-a-thon.Club meetings are held at 1:30 PM on the first Saturday of the month at the Minnetonka Community Center. Please stop by and visit if you are in the area.

San Antonio QRPadillos

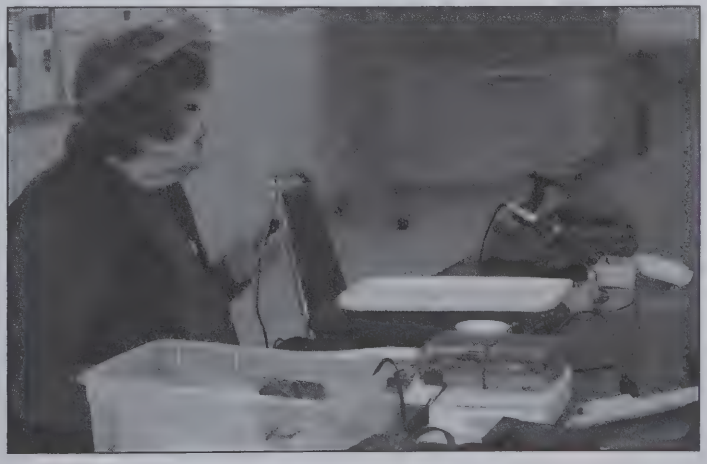
This group reports that there is not much going on at this time. They have been hampered by several days of freezing temperatures and several lost antennas to high winds and ice. However, code classes are going. Several members were portable for FYBO and various Sprints. They hope to get more going with weather changes.

North Georgia QRP Club

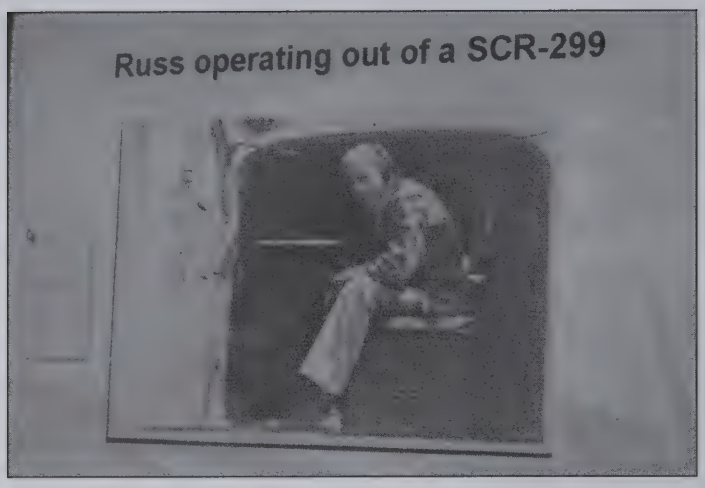
NoGa (North Georgia QRP Club) the club "without dues, without rules, and without officers" knows how to throw a party. This time it was to honor Russ Richardson, AE4NY, as his name was placed on the ARCI QRP Honor Roll, for lifetime achievement in amateur radio, and in particular, QRP.

Russ, a stalwart of the club, has been a ham forever. In fact, even before that, he was doing radio as a young recruit in the Army. He's been in NoGA since the beginning of the club and no one can think of an event that Russ missed.

The meeting tribute—hosted by John "Pickett" Cummings, AD4S—started off with a wartime video, "Voice of Victory" The film told the story about Russ' first rig, a Hallicrafters SCR-299, and how it began life as an amateur radio transmitter, the HT-4, and then was converted into a mobile rig for wartime field operations. The SCR-299 fit into a bread truck; the generator was dragged behind. The movie is a great one, about amateurs, the military, the military effort with a few war scenes shot on the beaches, we guess, of sunny California.



Minnesota QRP Society had a well-attended (and fun) build-a-thon, making a PSK meter.



Russ Richardson, AE4NY, in his early years as an army radio operator.

Russ was placed on the QRP ARCI's QRP Honor Roll and awarded this plaque, presented by Ken, W4DU.

After the film, the club saw photos of Russ as a young radiotelegraph operator—in the back of the truck. Boy! It must have been hot there. After the war, Russ went on to get his him ticket. He spent his days at Emory University, and his free time with amateur radio. He's done just about activity the club has had during the last 20 years-kitting parties, builds, field day, QRP camping trips, and socials. Russ was always there. He still organizes the annual holiday party. There couldn't have been a better honoree!

Ken Evans, W4DU, president, ARCI QRP presented Russ with a plaque to commemorate Russ' placement on the Honor Roll list.

NoGaQRP and the Atlanta area Hams did it again at TechFest. Techfest # 13 was an all-time success in both activities and attendance. TechFest is a gathering of clubs and hams interested in learning or showing methods and operating modes. NoGaQRP has been a regular participant in TechFest and everyone has become pros at showing off their gear. The January monthly meeting is held at TechFest. Since January in GA is generally mild weather, TechFest is their first chance of the year to get out and tell wild tales and interesting stories. And the NoGaQRP folks easily lead the pack.

Most all North Georgia clubs are invited to display at TechFest. Responses were in some cases a little slow, but they ended up with a room full of exhibits: 18+ displayed by 12+ different groups. Attendance was well over 300. Just ask the kitchen crew, they cooked burgers, dogs and chili enough for 320 and ran out. But not before everyone got through the line at least once.

Attendance included the ARRL, North Fulton Amateur Radio League (Youth Kit Building), Sewanee Amateur Radio Association (Satellite), Kennehoochee Amateur Radio (Echolink), Martin Ernst, KD4HLV (IRLP and Linux for Ham Radio), Southeast DX Club (Card Checking, DX, DX101), (Dan Nixon (Antenna Launcher Display and wire antennas), QCWA, Ralph Pickwick (Attic Antennas for Ham Radio), Amy Woodrick (Gwinnett ARES), Steve Back and Venture Crew 73 (Scouting and Amateur Radio), Ken Dalton (Youth Lounge), Ed Woodrick (D-STAR), North Georgia QRP (QRP and Fun Radio), Atlanta Radio Club (Ham Radio on your Smart Phone), Alford Memorial Radio Club (Winlink, Client Server, Packet), Silver Comet Amateur Radio Society (FLDIGI), GA Chapter of 10-10 International (10-10, 900 MHz in North Georgia)

NoGaQRP participated in TechFest in January.

The tailgate started about 8:00. Not a lot of participation, but it was a little cool. Norm (WA4ZXV) heard of several great buys, so I guess it was a success for the buyers and sellers. The show started early this year. The VE session started at 9:00, and the youth building project started at 9:30. That was pushing the regular start time of 10:00, but what the heck, everyone was there anyway. By 10:00 almost everyone was setup. By 11:00 you couldn't "stir 'em with a stick". Once again, the extreme efforts of the North Fulton Amateur Radio League paid big benefits. Several young folks completed their first electronic kit. And from the looks, many will be hooked on Amateur Radio for life. The NoGaQRP folks, their own Rich, K7SZ, Ken,W4DU, and Chris, K4FH, along with many NoGaNaughts kept a group of spectators entertained for hours. With the emphasis on digital communications in EComm work, they had great interest at the several

"how to" digital tables. And if you had a youngster there, Ken, KI4BQS, and Scott, KF4PWI, had plenty of activities.

Lunch was served about 11:30 with their traditional burgers, dogs and chili. This year there were more entries in the chili cook-off than anyone remembered in the past. The anonymous judge made a great selection when it was found out Sandy, KJ4DRO, was the winner. They think they emptied all 10 crock pots and then went into the store and bought to keep some available. The kitchen crew did an outstanding job.

Door prizes were handed out all morning with the grand prize a Kenwood hand held given away about 1:30. Thanks Kenwood for helping with the grand prize.

All the crew working TechFest hoped everyone had a great time. And thanks to everyone for being there, supporting Amateur Radio, being great Amateur Radio operators.

Midwest HomeBrewers and QRP Group had a big display of QRP equipment and projects at the Lincoln, Nebraska convention and flea market.

Midwest HomeBrewers and QRP Group

Sometimes besides sitting around and building (which is normal for this group—I have been there), the group gathers up a bunch of stuff, go somewhere and do a show and tell. Last year they went to the Lincoln, NE convention and flea market. They set up a couple of tables and put a lot of QRP equipment on display. Nothing was for sale, just for demonstration and answering questions about QRP and kit building or even building from scratch. Lots of folks were interested and many questions were answered. A couple of people even showed up at the next meeting in Ashland, NE to hear and learn more. The group feels they need to more of this. Check out their website at: http://www.hbqrp.org for more. Drop in any second Saturday of any month.

I do hope to make Ozarkcon for my next column but at this writing I am not sure if I will be there. The Midwest Homebrewers and QRP Group will again be hosting the Ozarkcon building session Friday night and are doing an interesting transceiver designed by David Cripe, NMØS. The unit was dubbed the "Ham Can" as it fits into a deviled ham spread can (smaller than a tuna tin) that you will find in your grocery store. More about all of this later.

GQRP Club

Tony Fishpool, G4WIF, wrote to tell me the date has been set for the Rishworth QRP Convention in case anyone wishes to make a pilgrimage to the UK. The date is Saturday, October 22, 2011. There are loads of photos from the Rishworth 2010 convention from John, G7NSN, at: http://tinyurl.com/4nv9sho. Feel free to lift a copy from: http://www.gqrp.com/reishworth.htm. This site includes pictures of the 2009 Rishworth convention, a site for a map, and information on places to stay and eat.

Guess that is about it for now. Again, I ask for information from your club or group for this column.

—72, Tim, WB9NLZ

Is it Time to Renew???

Your basic QRP ARCI membership (and member number) will last forever ... BUT, your continued subscription to QRP Quarterly requires you to be an active, dues-paying member!

Renewal notices are included on your mailing label, and also sent by e-mail (if we have your address). You can also check your expiration date online at the club web site: www.qrparci.org — just click the "Member Lookup" button on the left side.

Send your renewal online using PayPal, or by check to the QRP ARCI Secretary using the form on page 64.

Clandestine Antennas

William Cunningham—K4KSR k4ksr_@verizon.net

Many hams are faced with restrictions on the installation of antennas. These may be official, like covenants and deed restrictions, or maybe you just want to keep neighbors happy. The whole point of this article is to set aside your desire for "best antenna practice" and work for an acceptable antenna that isn't discovered.

Motive and Strategy

Hiding an antenna does require taking some risks and definitely some Chutzpah. Rather than worrying about being caught, it is better to think like a master spy catcher to suppress the evidence he might find. Evidence of an antenna is created before, during and after the actual installation. Raising an antenna entails a number of distinct activities that can be separated in both time and space. Some can be concealed, others are observable in whole or part—and some of these can be disguised. You want anything observed to be uncorrelated with anything else that is observed. You can't avoid revealing some dots, but you must make it very difficult to for somebody to connect the dots.

Threat Assessment

Before you start, do a good threat assessment. Who can see what and at what hours of the day? Who cares? Can you arrange antenna so that an observer on each flank or behind can't see enough to figure out the whole story? What are the odds that two observers will compare notes of partial views? Where do children play and are they supervised from within building or from outside? Are there hours when play is concentrated where you want the antenna or hours when there is no attention there? Visit neighbors to determine what they can or cannot see. Consider different seasons and sun angles. Identify the neighborhood Gauleiter who gets his/her jollies by ramming rules down everybody's throat, plus the neighborhood busybody who will gossip about any activity. The latter will be more interested in what people do rather than things. The Gauleiter scans for building/property changes that he/she has not personally approved. You are hiding the result from the Gauleiter and disguising the process from the busybody.

Figure 1—This photo taken from about 70 ft. distance shows the glint than occur when the sun hits bare wire or monofilament support line.

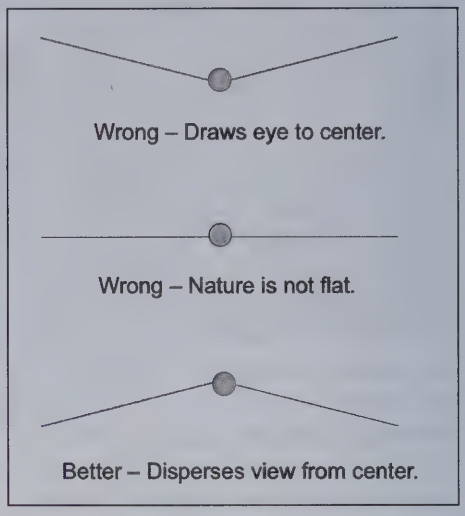


Figure 2—Straight wires are unnatural; sloped wires are less likely to be noticed.

Observability

Winter is a good time to study sun angles and trees. What goes up in summer may be very evident when leaves are down. Beware of glint off bare wire or monofilament line (Figure 1).

The antenna itself is completely hidden in the trees. What you see is low angle winter sun lighting up a monofilament fishline used as a downhaul tether for the ends of an 80m dipole. This line is downright invisible in any other light. Bare or varnished copper does the same thing. So plan on subduing both wire and support lines. I've settled in on #18 stranded wire with black jacket. This is far stronger than the "stealth" wires and is practically invisible at 20 ft. And you don't have to sweat glint or paint to avoid it. Spray all tackle and hardware with black paint.

You want antenna in slight inverted V. he tether ends must not be higher than feed or the eye will be attracted to the feed. Horizontal wires create a catenary that is unnatural, but the slight slope disguises the catenary (Figure 2).

Tree, Wire, Feedline and Antenna Options

Coax or directly fed longwire are the only realistic choices. There is no variation of parallel feedline that isn't obvious. I am devoted to RG-6. It works fine with a vertical, dipole or Windom, exhibits very low loss, is made to be buried, is cheap and when exposed, is familiar to to most people since it ordinary TV cable.

If you can hide the feed point, you might think in terms of a Windom. This antenna will handle multiple bands with ease and takes a single feed; but it does require a balun—which can be homebrewed into a pill bottle for QRP power levels. In general, avoid multiple traps unless you can hide them in a PVC flagpole or downspout. Don't neglect the possibilities that only require a single tree for support, and can be configured to cover two bands of choice with simple loading coil, e.g., Lake Eyre vertical.

Part of your decision on antenna type involves how much attention the setup process will attract. If you can throw something up in a few minutes, you can probably pick a time to do it without external supervision. When I first started with hidden antennas, somebody suggested throwing up a sacrificial wire to see if would be torn down, not a bad idea. I tried that for a while with coax into garage that I could disconnect. Learned a lot—ran into the glint issue immediately. And I learned to premeasure wire out of sight, but then wound up spray painting it to cover the glint. The great problem with measuring or painting in public is the time you are exposed to view. Busybodies will wonder what you're up to...

How High is Up?

This is not about best antennas, but about undiscovered antennas. Anything over 10-12 ft is outside of direct vision. That height allows you to move quickly with a simple stepladder or stick to lift over branches and is a great way to see if it is noticed. The upper third of tall trees sway a lot in a big wind, requiring slack or elastic support lines to protect fragile wire. Tops of tall trees leave the wire silhouetted against sky. I now prefer to stay below 1/2 the height. What you really want is a wire obscured in the visual clutter of branches its own height, but you also want a wire free from flailing ends of those same branches. This puts you into the tree trimming business that limits how you approach the whole game. Enter the most important tool: the telescoping tree trimmer. These expand to 12' or 14' length and can be expanded to over 20 ft with a length of PVC conduit. Best of all, you can slip a large nut over tip of the curved saw with pilot line attached and then flip the weight over any branch within reach. So now you have a relatively quick way to deal with antennas in the 25'-30' range using the tool and no more than a small stepladder. The other approach is to cast/sling/shoot a weighed line over something higher. I do NOT recommend the standard slingshot because it takes too many attempts to get the right branch and you run the risk of putting a long miss onto a neighbor's roof. Better to use a wide slingshot product called Dog Launcher that shoots a tennis ball with some accuracy. Another tree surgeon's trick is to sling a 12 ounce weight on a light pilot line, less threatening to observing neighbors than somebody with a slingshot. Multiple attempts to launch a weight over a high branch invite observation, regardless of technique. Practice elsewhere so that you can minimize your exposure at the home QTH.

Returning to the question of height, I find quick and dirty at 12'-15' works just fine for the initial trial and for quick replacement. Anything over 20' requires some preparation and some thought about how to maintain the wire. Remember that evidence is created before, during and after erecting the antenna. Higher antennas favor repair over replacement. For that reason, my 25'-30' antennas have all involved halyards that are tied off at about 10' above the ground to avoid easy eye contact. All tackle is spray painted black and black parachute cord or even smaller dacron kite line works well and provides good elasticity. I use monofilament fish line (sprayed black) for the low antennas and to tether ends drooped down.

Construction & Scheduling

Assuming you opt for something that requires significant preparation, break activity into discrete steps that are spread over time and appear unrelated. The more you can incorporate preparation steps with legitimate yardwork, the better. Any activity like wire measurement or trimming should be performed indoors or at some other place. Provide a cover story for each task that preserves the separation. Hide what can be hidden and disguise what you can, both objective and actions. Exploit and generate clutter that distracts the eye. Almost all the CCR make exceptions for non-antennas, e.g., children's play equipment. Read carefully and exploit creatively. (Remember that magicians occupy audience attention with one hand while they do their trickery with the other hand.)

If you do try a vertical, you will need to bury radials/counterpoise with same technique as coax. A simple slit in the turf is sufficient. Hint: you only need a single radial to get a directional pattern. One thought on 'having a plausible story'—W3TUA reports being discovered whilst burying radials for a birdhouse vertical and quickly explaining he was installing invisible electric dog fence. No home should be without one.

The most obvious way to deal with RG-6 out in the open is to disguise it as TV cable. You can run it more or less as the cable guy would. Terminate with a gray PVC electrical box that looks official. Bury into ground inside a short length of PVC conduit, looking official. If building is old enough to have been painted, splatter some of the old color (aged) from place to place. New things are suspect. Old things are not, so the more you can make the installation look like it has always been there, the better. Think in terms of a junction box housing balun and feed point with long end running the length of neighbor's quarters. :-) You can also wind your own miniature balun for the power levels you intend.

Don't feed a wire in midair where it stands out. Always on back side of tree. If you run coax up a tree, wind 1-2 turns around the tree up to the feedpoint. Make the spacing and pitch slightly different for each pass. When the feedpoint is lowered, this collapses easily. When up, the observer never sees the entire length of coax. If feedpoint is on opposite side of tree, there is no obvious connection to the vine. In spring, plant honeysuckle next to coax and start a runner up the line. It grows like crazy. Don't plant kudzu, however. :-)

One last thought about coax. RG-6 uses F connectors, cheap and available. You don't need BNC. F connectors are very reliable if done right and can be taped securely and waterproof. I've had to route coax all over the place and found it convenient to break into segments for ease of construction and troubleshooting. It's not necessary to have a long unbroken run snaked all over the place. If you ever have the luxury of burying coax unobserved, put in a double run, looped back at the far end. That will keep it dry and provide expansion room.

Your coax will run to base of tree holding feedpoint and you will make many trips back and forth. Make sure your beaten path extends past the tree to some plausible destination. Also, depending on the yard, you might want a water source out there for a birdbath, fountain or watering. It's a perfect excuse to run coax with or within the hose. Don't need to bury below frost depth, just below lawnmower cut point. You can even use a Y-connector at each end of hose to run water in the same hose, but it takes some clever sealing to make it work. The watering point is a convenient spot to hide the exit from hose.

Use (dark contrasting) landscaping, bird feeders, birdbaths to attract eye to the foreground and away from the offending trees. Don't hang a birdhouse on the feed tree... :-) A bird feeding station forward and to side will attract the eye. The birds will sally from trees, but will not sit on #18 wire. Their movement is more of a distraction, even if they sit near the wire.

To keep banging on the same drum, hide what you can and divide observable objects and observable events into discrete bundles and cause those bundles to remain uncorrelated. Generate plausible explanations for each bundle.

Attic, Gutter, Conformal Antennas

Attic antennas provide the ultimate concealment whose performance is sur-

prisingly good or surprisingly bad. The biggest problem is the presence of ductwork and/or HVAC machinery. It's always worth a try. Start simple to get an idea of what will work. Trapped antennas require more adjustment than a single band dipole cut by formula, so think in terms of a 20m dipole as providing the most result for the least work. This can be extended to a fan dipole for 20/15/10m. Cramming lower band antennas into an attic will require some clever bending, for which access is the key. If you are lucky enough to install pulleys during construction, you are ahead of the game. If not, consider projecting a pulley system into corners using telescoping PVC sections to reach where you cannot crawl. If the roof pitch is not severe, high band inverted Vs can be fashioned perpendicular to a HVAC trunk line.

You cannot guarantee major success in the attic, but you can guarantee total stealth. Take what it gives you in terms of space and access. Just remember that 100 W into the attic may cause mischief with other things within the house, but 5 W isn't a problem.

I've never had luck with gutter antennas, but some have. PVC downspout material from soffit to ground, however, will hide a trapped vertical and look like a secondary attic AC installation. A longer conformal antenna can be wrapped around building near window level from most multistory buildings. Depending on the exterior surface, you can sneak an invisible wire or use the shield of RG-6 that looks like a TV cable. Symmetry need not be perfect. In fact, a Windom provides a great opportunity for a multiband asymmetric antenna with ends bent around end of the house. Just remember that the events surrounding installation must be as plausible as the end result.

Summary

Do these antennas work? You bet!! Some work better than others, but all work better than no antenna. None are likely to satisfy a top dog contester, but you would be surprised what can be achieved. Complementary coverage from two modest wires at 25' will make you wonder about monster arrays on a 60 ft tower. My clandestine antennas have all incorporated complementary wires, double the effort with 4 times the result. I'm pushing 200 DXCC entities with 5 W and 75 with less than 1 W and have worked WAS with average power of 100 mW. Attic antennas at new QTH have yielded DXCC and WAS within a few months.

●●

The Joy of a Hole-in-the-Ground

Craig Behrens—NM4T CraigB44@MSN.com

Why would an amateur radio operator get all excited about a hole in the ground? And what possibilities could such a simple thing present to a QRPer?

Perhaps, like me, you're a victim (from a Ham Radio frame of reference) of homestead deed and homeowner association restrictions. Almost any new house comes with a highly restrictive neighborhood contract, one that precludes anything that resembles amateur radio activity. It's OK to have the world's ugliest gym sets, patio set-ups complete with massive fire pits and other socially accepted paraphernalia, but antennas and towers are forbidden.

So what are we to do? Should we simply roll over and totally compromise to those who are able to enjoy their interests at the expense of ours? Start a war with the homeowner association and city institutions? Or, find a way to work the restrictions at the fringes of interpretation? Here's where a hole in the ground may create new radio enjoyment opportunities for you as it has for me.

I decided to dig my hole-in-the-ground near the center of our backyard. This was, in part, a strategic decision that provided a "Plan B" so that a vertical antenna that looks like a flagpole could be installed should the neighbors decidemy flexible

Photo 1—Everything needed is ready.

system approach was not acceptable.

The hole design (yes, one can design a hole) is approximately two and one half feet square, and almost six feet deep. My goal was to provide enough mast support strength (below the ground) to eliminate or, at least, minimize the need for unsightly guy lines. My implementation required 50 pounds of gravel in the bottom for moisture accumulation and seven 80-pound bags of ready-mix cement. A six-foot length of two-inch diameter PVC pipe is positioned in the center to accept insertion of a mast. When finished, I inserted a sixteen-foot long, inch-and-one-half diameter, thick-wall pipe into the hole's PVC receptacle. This serves as the antenna mast that I attach my antenna to. As an alternate, telescoping or stackable masts could be used, should you need to be able to extend and retract your set-up between radio operation activities.

For now, I've decided to avoid using buried radials. I will limit my choices to balanced antennas or those that can include a "stealth" aerial counterpoise approach. Ham sticks, for example, can be used for this purpose in some antenna configurations. Further, by design, I will be able to use all the antenna and mast components in other field locations when desired. This design approach allows this set-up to be kitted-up for grab-and-go radio operations.

The cost for my hole-in-the-ground project was just less than $50, including a plastic cement-mixing tub ($12) that you might not require. The following materials were used (See Photo 1):

- Seven 80-pound bags of ready mix cement
- One 50-pound bag of gravel
- A plastic cement mixing tub
- A 6-foot length of PVC pipe and cap (for when not in use)
- A 6-foot length of copper clad ground post (optional, purchased later)

This a good place to mention that a hole-in-the-ground project requires a lot of sweat equity—please don't over-extend yourself. It took me a whole day to do this project—with a LOT of rest breaks. It will take a couple days, if I'm lucky, for my back and hands to forgive me! (Photo 2)

For electrical safety, and for antennas that require radials, it is wise to have a good ground rod at the antenna location. Here, I had two main design considerations for the ground post: 1) I wanted to make sure it didn't stick out where I would accidentally find it when doing lawn maintenance; and 2) I needed the option to drive it deep into the ground should I decide to move someday. So I drove it into the ground at an angle, away from the cemented area, to where the top was flush with the ground. A PVC cap was installed over the top of the ground rod to make it accessible while avoiding the possibility of someone accidentally tripping on it and getting hurt.

While the concrete set, I entered ideas into my Ham project notebook as to what I could do with my brand new hole-in-the-ground. Discretion being the better part of valor, I decided that my first antenna configuration should be as visually modest as possible. You know—get the neighbors accustomed to the idea of alien objects in my back yard. Hmm, should I do a vertical? How about a loop or couple wires? How about a delta loop? I've always wanted to fool around with a vertical dipole...

My first application, I decided, makes use of a Diamond CP6 6-Band Trap Vertical (80, 40, 20, 15, 10 and 6 meters). The base of the antenna is mounted approximately eight feet above the ground, which places the tip at 23 feet. (Photo 3) This is a reasonably compact antenna with modest visual impact. Of course, it still does have an alien look about it that will serve as a test to see how much feedback I get from my neighbors. Whatever feedback I receive will be carefully considered in deciding the next antenna configuration I will install. Perhaps something a little higher, more effective and an additional wire antenna would be in order.

(NOTE: The lady living next door to me was the only person that asked about my antenna. She was simply curious, had never been exposed to amateur radio before. We chatted for thirty minutes about what my station was all about and what I could do with the simple set-up. I never heard from anyone else, and … the HOA President lived three doors down the street from me.)

Photo 2—Depth and size of hole compared to the length of thepost-hole digger handles.

Photo 3—On-the-air with the first antenna application.

Future antenna configurations will use alternate lengths and materials for the mast, depending on the weight, wind load and height of the antenna in question. All approaches will attempt to maximize antenna performance while minimizing the visual impact to my neighbors. For example, a lighter weight mast can be used to support a wire antenna vs. a mast that must support an aluminum dipole or compact beam. (A beam would, most likely, be stepping over the line in terms of visual impact.) In addition, if guy lines are required, a minimal number would be used and they would be as thin and low as practical. For a delta loop, for example, the two legs of the antenna can also serve as guys if heavy wire is used. Then, only two guy lines would be required, perpendicular to the antenna, at the 2/3 height point to support the mast.

If you pursue this or a similar approach to be as compatible with neighborhood restrictions as possible without giving up the ability to have an outdoor antenna, and you are confronted—calmly state that your antenna set-up is not a permanent structure. It's temporary and can be quickly and easily removed. (Diplomacy is key here.) You can also point out that flagpoles are (usually) allowed which is not so different from what you are doing. In either case, this hole-in-the-ground approach will not meet the literal contract language or intent of your neighborhood agreements, but carefully applied; it could give you some leeway. Whatever approach you decide to take MUST be safe and perceived as safe by the uninitiated. Further, think visual impact—how you route your feed lines, for example. Anything that can been seen as unreasonably cluttering-up the neighborhood view can have a negative impact on your chances for success.

In hindsight, my hole in the ground project could have been a lot easier and more fun if I had pursued it with an Elmer. This would have been a great opportunity to discuss many ideas and concepts. Perhaps, the old "Huckleberry Finn" approach could have been applied to significantly reduce the stress to my body. (Remember when Huck talked his friends into doing his work, whitewashing the picket fence for old Aunt Polly?)

QRPers are a hardy breed, well equipped to deal with adversities and limitations such as deed restrictions. Hopefully, I have tweaked your interest for a similar type of project where a lot can be accomplished with some QRPer ingenuity, modest cash investment and a little sweat equity. Finally, I'd like to hear from you as to what antennas might work best with the design constraints listed in this article.

—72/73, Craig, NM4T

●●

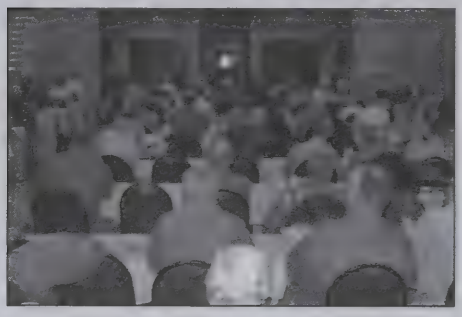
FDIM Preview!

Norm Schklar—WA4ZXV fdim@qrparci.org

FDIM - Four Days in May
May 19-22, 2011

The Premier North American QRP event this year! Get it on your calendar now! Thursday-Sunday, May 19-22.

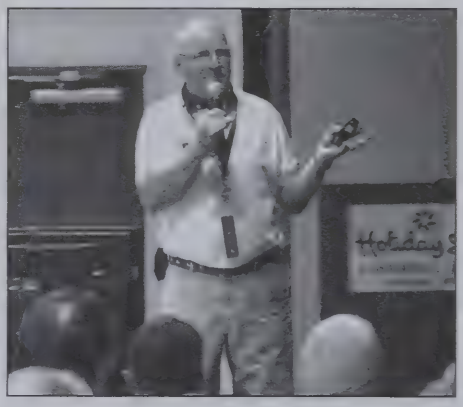
What a great FDIM we have planned for this year. If it's your first or 16th, there will be something here for you. QRP-ARCI is sensitive to the first time attendee and will try to make your first FDIM as fun and interesting as possible. We will also have spouse/guest activities.



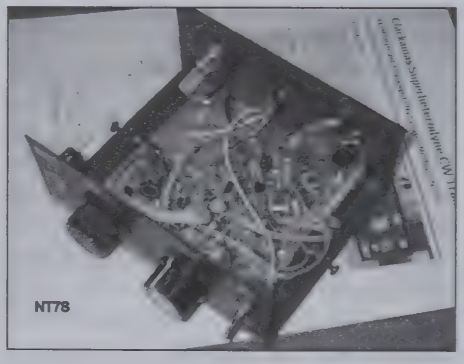
Registration and getting acquainted begins on Wednesday evening. Seminars are most of the day Thursday, with "meet the speakers" and an open room for some casual show and tell, vendor displays and plenty of time to swap tales. Most of Friday daytime is open to attend the Hamvention® and visit the QRP-ARCI Toy Store. We'll have plenty of room at the hotel during the day for casual meetings

and time to visit with old friends and make new ones. This year we hope to open the Banquet area for Vendors and some other learning experiences. Friday evening activities usually include "show and tell", vendor displays and a judged home brew contest. Most of Saturday is again open for

the Hamvention, and we have a great social event, our annual banquet and awards presentation. There will be plenty of door prizes that evening. Sunday is the Hamvention and check-out.



Most of the speakers for the seminar have been contacted and confirmed. We'll have a "meet the speakers" social gathering after the seminar, where you'll have an opportunity to meet, question and discuss QRP with the speakers.



Don't miss out on the show and tell. You'll have an opportunity to bring out your QRP related projects and put them on display. Your contemporaries will have a chance to roam through the displays and see the excellent craftsmanship used in these special exhibits.

We'll have a judged project contest and it shouldn't surprise you to find a fun contest or two during the weekend. We've had QLF, split paddle, and other fun activities in the past.

QRP related Vendors are invited to exhibit both Thursday and Friday evenings. We're sure you'll find many special FDIM discounts.

The hotel is including breakfast with the price of the room. The hotel has been very accommodating and a pleasure to work with. You'll find fast food restaurants across the street from the hotel. Dress is casual for all events.

We will again be at the Holiday Inn, Fairborn, OH. Reservations and special room rates for FDIM are available through www.FDIM.QRPARCI.org. Remember, all discounted hotel rooms are released

only through QRP-ARCI. Instructions will be posted as soon as the hotel is ready to start processing our Room Block.

This is preliminary information. A complete schedule and list of activities will be posted on the web site as we move through the process.

Questions or comments:

Norm Schklar, WA4ZXV
FDIM2011 Chair
fdim@qrparci.org
ph 770-313-9410

(Last updated January 11, 2011)

FDIM 2011—Homebrew Contest and Show & Tell

As in the past, we intend to allow entries in the Homebrew Contest* to be displayed in the Ballroom on Thursday night, May 19; and Friday night, May 20, between 8 p.m. and 10 p.m. To enter an item in the contest and insure that it is part of the voting (on Friday night), you must register your item on either Thursday or Friday night between 7 p.m. and 8 p.m. A registration table will be outside the main Ballroom at that time on both nights.

Each entry will be given a card that lists the category and item number, along with a description of the item and the call sign of the owner. This card must be displayed with your entry.

Judging will be done between 8 p.m. and 10 p.m. on Friday night, so although you can display your item on both Thursday and Friday nights, your entry must be displayed Friday night to insure it is part of the voting. The judges will be the attendees of the Vendor night on Friday. Each will be given a ballot that must be submitted by 10:00 p.m. on Friday. There will be six categories. They include:

1. All Homebrew (Xcvr, Xmtr, Rcvr)
2. Modified Kit (Xcvr, Xmtr, Rcvr)
3. Station accessories (homebrew or modified kit)
4. Test Equipment (homebrew or modified kit)
5. Antennas
6. Special Category
7. Best of show

Winners will be announced at the awards banquet on Saturday, May 21. If you are bringing an item for the Show & Tell* and do not wish it to be judged, you need not register, simply come to the ballroom between 7 p.m. and 8 p.m. and set it up on a table that we will assign to you. Whether you are part of the Homebrew Contest or the Show & Tell, please let us know your intentions when you register so that we can assure we have adequate space for all.

***Definitions:**

Homebrew Contest—You bring one of your latest projects and display it. On Friday night, attendees will be able to vote for a winner in one of the categories.

Show & Tell—You bring one of your latest projects and display it. Your project will not be part of the voting in the Homebrew Contest.

2011 FDIM Information Summary

Dates:	Thursday, May 19 through Sunday, May 22
Location:	Holiday Inn Fairborn, Fairborn, OH (Dayton area)
Registration:	Online—www.fdim.qrparci.org
Hotel:	Through QRP ARCI only—info at www.fdim.qrparci.org
Seminar:	Thursday, May 19, 8 a.m. – 4 p.m.
Activities:	Buildathon Homebrew Contest Show & Tell Vendor Night Meet the Speakers Guest/Spouse Program Awards Banquet (with many door prizes) And of course, the Dayton Hamvention®

VHF QRP: Sporadic-E Season is Upon Us

James Duffey—KK6MC jamesduffey@comcast.net

In the late spring and early summer six meters comes alive with signals, some strong, some weak, most within 1400 miles; a few from farther out. Signals can come and go quickly or stay in all day. Signals can be very strong or extremely weak. The signals can all be from the same geographical location, or they can be spread out all over the country. It is an exciting time to be on six meters!

This enhanced propagation happens even if the solar flux is low. It happens when it is high. It happens in between. What is this propagation phenomena? It is Sporadic-E propagation, sometimes called E skip, and sometimes just short skip. Sporadic-E is caused by large patches of ionization in the E-layer of the ionosphere. The exact cause of these patches is not well known, but they are associated with wind shear and some think they are connected with high towering thunderstorms. These patches of ionization are not caused by solar activity as is the ionization in the F layer with which we are more familiar.

Unlike tropo, meteor scatter, EME, and other weak signal VHF modes, Sporadic-E signals are often very strong. You can work many stations with QRP during a Sporadic-E opening. You will miss the weak ones when the band opens and closes, but there is usually much there to work with QRP when the band is open.

As the E-layer is about 70 miles high, single skip is limited to about 1400 miles. Double skip is possible, but because of the patchy nature of the ionization, double skip requires two patches at the right distance apart, which are not always available.

E-layer skip occurs most often from 0900 to 1100 and 1900 and 2300 local time (not UTC!), although it can occur at any time of the day. It is most common between mid-May and early August, with a secondary season between mid-December and January.

How often can you expect to hear Sporadic-E on 6M? WA5IYX's monitoring efforts indicate that there are, on an average, 125 hours of Sporadic-E in a season at 88 MHz; there will be more on six meters. Similarly, 60% of the days in a season had Sporadic-E openings of a half hour duration or longer. These are averages, some years are better, some are worse. So if you listen often enough in the morning and early evening you will be able to work Sporadic-E on 6M.

The best way to find an opening is to monitor the six meter calling frequency, 50.125 MHz, or the six meter beacons. There are a number of beacons scattered around the country between 50.05 and 50.08 MHz. Often these beacons can be heard weakly when the band is otherwise closed. When the band is open at all there is almost always someone on the calling frequency, so that is a good frequency to check. If you hear a beacon or two, but nobody on the calling frequency, get on and call CQ. Please observe the calling frequency etiquette and if the band is open at all, move up from the calling frequency. There is plenty of room on six. Also observe the DX window between 50.100 and 50.125 MHz. This window is reserved for QSOs between continents. Don't operate there unless you are making a DX contact. You will hear the DX window abused often by lids, but don't join in this activity.

An excellent way to alert one to six meter openings is via the Internet. The DX Sherlock web site, www.vhfdx.info/spots/map.php?Lan=E&Frec=50&ML=M&Map=NA&DXC=N&HF=N&GL=N, hosts several real time propagation maps, including one that shows QSOs made on 6M within the last half hour and one that shows the location and maximum usable frequency (MUF) of the sporadic E clouds. It is worth bookmarking this URL and checking it often during the Sporadic-E season, and you may even consider making it your home page!

Nothing beats listening on the band though, so I usually have the calling frequency tuned in on the six meter rig when I am home during the Sporadic-E season. If other family members complain of the white noise, I use a light bit of squelch. You will miss the real weak ones, but you will hear most openings this way. With SDR and rigs with panadapters becoming more common, it is possible to "see" band openings. Look at the beacon frequencies, or the frequencies above the calling frequency.

With the advent of HF rigs with six meter CW capabilities, CW activity during Sporadic-E six meter openings is on the rise. Most CW on six is concentrated between 50.08 and 50.100, with 50.90 to 50.100 in heaviest use. If you don't hear anyone using CW give a call anyway.

The E-layer ionization patch, once generated, will drift to the northeast at a speed of about 180 mph. The ionization patch is what reflects your signal and is at the midpath of your contact. You can use this to predict who you will work next. Often an ionization generating spot will generate several patches, so you will notice cycles. From my New Mexico location a Sporadic-E session might start with New Orleans coming in loud, then move to Arkansas, St. Louis, and if the cloud lasts a long, long time, Omaha, Sioux Falls, and even Winnepeg. Often I can hear several of these locations simultaneously, indicating that several ionized patches are present.

The location of the generating source moves east at about 12.5 degrees per day, so if you had short E-skip in the morning you may have long E-skip in the evening, and if you had short E-skip in the evening you may have long skip the following morning. If you worked to the west yesterday, you may work to the east today or tomorrow. So, if I hear New Orleans today, I may hear Alabama from the same patch tomorrow. If I work California, I know that there are probably several more days of E-skip to come, and I will plan my future activities accordingly.

When the skip becomes very short, it means the ionization is very dense and propagation at the next higher band is possible. So if I hear Dallas working San Antonio on six, I know I have a good shot of working somewhere in Dixie on 2M. Sporadic-E openings on two meters are also associated with very long and widespread openings on six meters, so if six has been open all day, be sure that you monitor 144.2 MHz occasionally and even give a call on 144.2 MHz. Asking stations you work on six during a sporadic-E opening to try a QSO on two meters is also a good strategy.

Monitoring ten meters for Sporadic-E propagation is a good way to have an alert that six is open. If ten has been open for a

while, then look to six, particularly if the skip is short on ten meters.

On the other hand, if you need states close in for 10 meter WAS, looking for them on ten meters when six meters is open is a good strategy. The skip will be shorter on ten. But be sure to come back up to six.

If you want more information on Sporadic-E, look at the ARRL publication; "Beyond Line of Sight," which contains articles on several VHF propagation modes including Sporadic-E. A very useful and informative *QST* article on Sporadic-E is by W3EP and WA5IYX, "Eleven Years of Sporadic E," in the March 1992 issue, available for download from the ARRL site to members. Also, the VHF column in *QST* often has hints and information on working Sporadic-E on 6 meters. These are usually in the May and June issues. When it comes to Sporadic-E, 10 meters is a VHF band, not an HF one.

Contests

The June ARRL VHF QSO Party is held the second full weekend in June; this year it is June 11-13, 2011, beginning 1800 UTC Saturday, and running through 0259 UTC Monday. It is one of the best VHF contests as far as activity goes. There is a QRP Portable Category, which requires operation from a portable location on battery power with less than 10 W PEP output. Check the rules at www.arrl.org/june-vhf-qso-party for all the details. If six is open, most of the activity is on six. It is hard to get lots of QSO points, and hence a high total overall score, any other way. If six is not open, then most of the activity is on two meters. A good strategy if you have more than one band is to move the station through all the bands you have in common after the initial contact. This results in the most QSO points and multipliers for both stations. After you have exchanged initial information, ask "Do you have any other bands?" Be sure to send in your log when the contest is over. There is always lots of activity in the June contest, so if you are hunting grids, this is a good time to pick them up.

The second big contest of the summer season is the CQ WW VHF Contest. As I write this the 2011 dates are not posted on the CQ contest site, but is usually the third weekend in July, which would put it beginning at 1800 UTC Saturday, July 18, 2011 going through 2100 UTC Sunday, July 18, 2011. Check for the latest rules here www.cqww-vhf.com/rules.htm. There is usually enough Sporadic-E to make this contest interesting, and as the contest only covers 6 and 2 meters, it is a bit less hectic to operate. There is a Hilltopper category, which is ideal for the QRP contester who likes to operate in the field. It is interesting in that there is a time limit of 6 continuous hours for this category, so you don't need to devote an entire weekend to the contest. You don't need to haul a battery to your operating site; any power source is acceptable. There is also a single-op low power QRP category that may be of interest to QRP ops who want to stay at home.

The ARRL UHF Contest is the first weekend in August, 1800 UTC August 6 to 1800 UTC August 7. There is no QRP category in the UHF contest, but as few stations run high power on the UHF bands and high gain antennas are easy to build and handle, it is easier for the QRP station to compete with the big boys on the UHF bands than it is on the lower bands. Bring your key or paddles; remember that CW is the big equalizer on VHF/UHF. If UHF activity is low in your area, you may wish to enter in the Rover category, a category where you can operate from more than one grid. Not only will you make more contacts, but the fixed station operators will love the additional grids to work.

Input?

If you have topics you would like to see covered in this column let me know and I will try to get a column written on the topic. If you have any pictures of your VHF/UHF QRP station, VHF/UHF activities, or homebrew VHF/UHF projects, send them in with a brief summary. If you have questions about VHF/UHF operation, feel free to drop me an e-mail. Until next time, listen for the weak ones.

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To start, just send a note with your idea to the Editor, columnist, or an Associate Editor.

A Learning Environment for Digital Signal Processing

Ward Harriman—AE6TY ae6ty@arrl.net

Several years ago I embarked on a self-guided attempt to learn about Software Defined Radios. I was comfortable with simple RF design so I could implement the RF front end and I was comfortable with programming so I expected I could 'write the code'. My biggest hurdle was in understanding and applying the principles of Digital Signal Processing. This was a completely new discipline for me as I had only the most tenuous memory of learning about it some 30 years before. Those memories were not good but I was convinced that I now had the time and the interest to gain at least a passing understanding of this important technology.

As I read about the principles and techniques of DSP I found myself wanting to try my hand at actually writing code. For me, writing functional code was a kind of trial by fire. If I could write functional code then I believed I had a passing understanding of the principles involved. Unfortunately, in order to prove a program was functional I had to run it and to run a program, I had to have some input and I had to be able to verify the output. At this point, my progress fell precipitously because I could find no easy way to generate input and verify output and hook everything together.

My first attempt at writing programs came in the form of Excel [1] spreadsheets. Excel is very good at performing computations and graphing the outputs. Unfortunately, it is not so good at generating input and it is a very poor programming language for DSP applications.

My second attempt was to use C and write programs to generate input and to graph the output. This approach allowed me to generate sophisticated input, write my test program efficiently and graph the output …more or less. While functional, this approach did not lend itself to general utility. C is a great programming language for DSP work but without self-discipline the programs quickly degrade to a heap of spaghetti. I was beginning to consider the idea of developing a methodology for teaching DSP principles and unadorned C simply wasn't a good vehicle. I believed the newcomer would quickly be lost in the nuances of C programming rather than in the topic of interest: DSP programming.

What I needed was a kind of "Integrated Development Environment" or IDE which would provide a complete environment for demonstrating DSP principles. The requirements I envisioned were:

- Provide a simple way to generate input of many forms
- Allow the user to write programs in a C like language
- Provide a simple way to connect segments of code together
- Display both inputs and outputs and any intermediate 'signals'
- Run on three different platforms: Windows, OS-X and Linux (of some form).
- Be free to anyone who wanted to use it.

I looked around the web for some time but could not find any applications of this form. This is not to say they aren't there, I just failed to find one. The engineering applications typically used for these functions failed on several counts. First, they were far from free. Second, there was a substantial learning curve involved with using them. And so, I set off to make an application of my own.

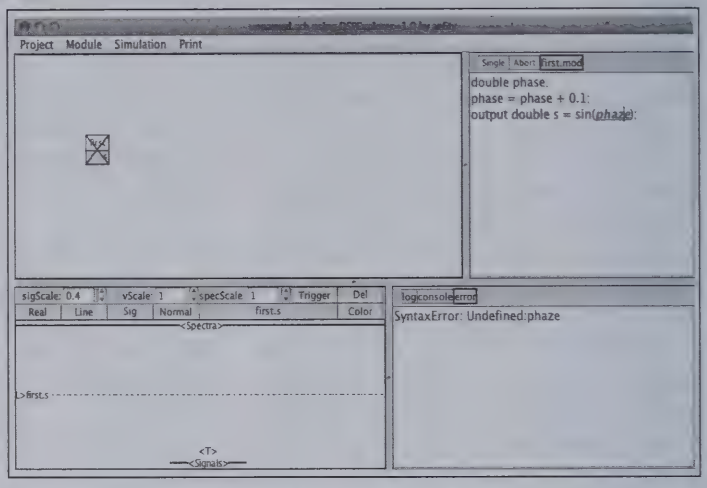


Figure 1—Default screen layout of DSPE.

What follows is an introduction to my IDE I named "DSPExplorer". Unfortunately, there is no getting around it: to get started in Digital Signal Processing, you have to read and eventually write programs. Fortunately, the programs are generally quite simple and certainly do NOT require anything even remotely sophisticated. All the programming skill you'll need to get through this paper is generally taught in the first week of a middle-school course on programming. If you aren't a programmer, here's your chance to start!

NOTE: This short paper does not discuss how to download or invoke DSPExplorer. That information is best conveyed using short video tutorials on my website, www.ae6ty.com, where you can also download DSPExplorer. Here, I will try to show the basic capabilities of DSPExplorer and, hopefully, pique the reader's interest enough to download it and give it a try.

DSP Explorer

When I started to write DSPExplorer I had recently finished up my Smith chart software (SimSmith, also available at www.ae6ty.com) and was flush with confidence. After some casting about, I ultimately decided that there would be four fundamental tools in my IDE. First, I would need a text editor. The text editor didn't need to be very sophisticated since most DSP program segments are quite short.

Second, I would need an interpreter or compiler. Unfortunately, many computers do not come with C compilers already installed. Rather than require the user to go and fetch and install a compiler, I decided to provide one built in. My compiler is not exactly C, more of a 'C-lite' but it is adequate for these purposes.

Third, I would need to provide a way for the user to structure the program and to reuse blocks. I decided that representing modularity in DSP code was best done using schematics. Thus, I

would need a simple schematic capture capability where the user would 'wire together' blocks of code.

Fourth, I would need a familiar output mechanism. Here, I decided to provide a very 'oscilloscope' like function. In addition to basic signal traces, the output subsystem should also provide 'spectrum analyzer' type functions.

Figure 1 shows the default screen layout of DSPExplorer. In this screen I have typed a program into the upper right hand window. Note that I have purposefully introduced an error. When the compiler encounters an error it endeavors to highlight (make red and underscore) the item it finds confusing. It doesn't always get it right, but it gets close. Additionally, the compiler attempts to describe the nature of the error in the 'error' window.

The window on the upper left hand side is the schematic capture window. There is only one block in our example so far and so only one block is shown. Note that there is a red X drawn through the box because there is an error in the associated program. The block also shows a single output called 's'.

The lower left hand window is the oscilloscope (and spectrum analyzer) window. In this case I have chosen the variable 's' as the trigger. This window can display any variable in any module. There is no limit on the number of traces which can be shown. Triggering can take the familiar forms of positive or negative edges and the 'level' can be adjusted using the 'L>' slider. The default is positive edges passing through 0.

The lower right hand window displays text output. There are three different 'panes' in this window. The 'error' pane shows error messages from the compiler. The 'console' pane shows messages which come from the program. Messages can be sent to the 'console' using the "println()" function call from the written program. Finally, the 'log' pane is used by DSPExplorer to inform the user of various internal events. Most DSPExplorer functions take place quietly in the background and the 'log' pane is rarely used.

Figure 2 shows the screen after I have corrected the error in the 'first' module, selected the "Simulate" menu and then clicked on "Run". Notice that there is now a trace on the oscilloscope and that the 'console' pane has been displayed in the lower right hand corner.

This simple example shows how the four basic windows are used in concert to develop a program using DSPExplorer. Everything that follows is really fleshing out the capabilities provided.

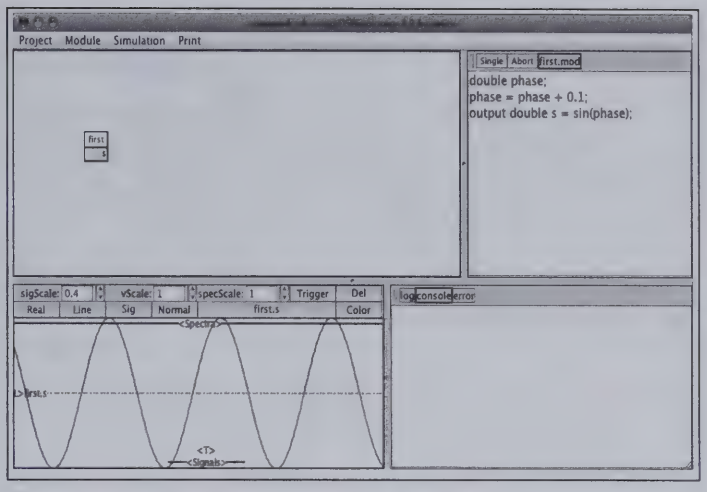


Figure 2—Default screen after correcting error.

Module Creation

Modules are created by simply clicking on 'Module' and then 'New'. DSPExplorer will ask you for a name. Once you have provided the name, DSPExplorer will create a schematic module of the same name and open the text editor so that you can write your code.

Every time you make a modification to a module, the schematic, or the 'scope, DSPExplorer updates the associated files and attempts to compile the code. When you exit DSPExplorer and then restart it, DSPExplorer endeavors to restore the design to the same state as when you exited. It doesn't do everything perfectly, but it tries!

Variables

DSPExplorer provides two kinds of variables: double and complex. A 'double' is represented internally as a 64 bit, IEEE-754 floating-point number. A 'complex' is two doubles, one used to hold the 'real' part and one to hold the 'imaginary' part. All variables must be declared before use and are initialized to zero by the compiler. All variables are 'static' in that they maintain their values between calls.

DSPExplorer also provides for single dimensional arrays. Array indexes are always positive and always start with 0; the '0'th element is the 'first'. Essentially all programming languages implement arrays in this way. DSPExplorer allow for indexes outside the obvious range. For example, element "-1" is the last element in the array. This is useful when implementing ring buffers. Sample declarations are:

```
double d;
complex c;
double  da[3];
complex  ca[4];
```

Basic variables and arrays can be accessed only in the modules in which they are declared and only after they have been declared.

It is almost always the case that a module will have some inputs and some outputs. There is no 'equivalent' concept in C so I invented my own syntax. Inputs and outputs can be arrays as well as basic variables. Some examples are:

```
input double ind;
input complex inc;
input double inda[12];
output complex[5];
```

It is often the case that when you write a module you will have an input which you know will be an array but you won't know what size until it is wired to another module. In this case you can write:

```
input double inda[];
```

There is one final variable type, the 'parameter', which can be used to initialize a variable via a value in the schematic. Figure 3

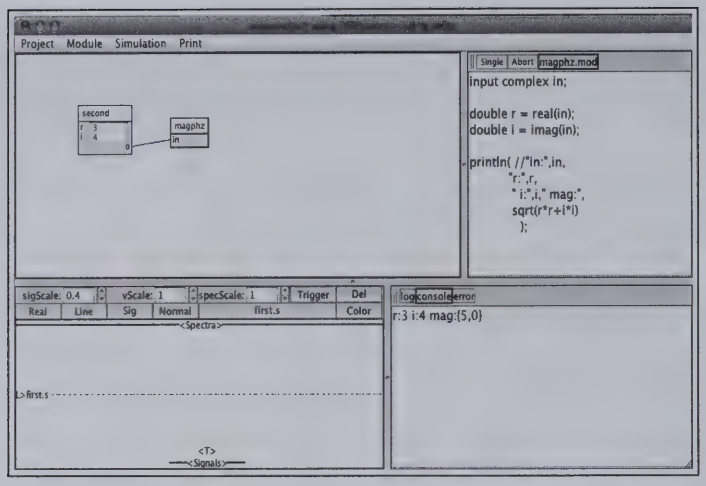


Figure 3—Using parameters to provide constants.

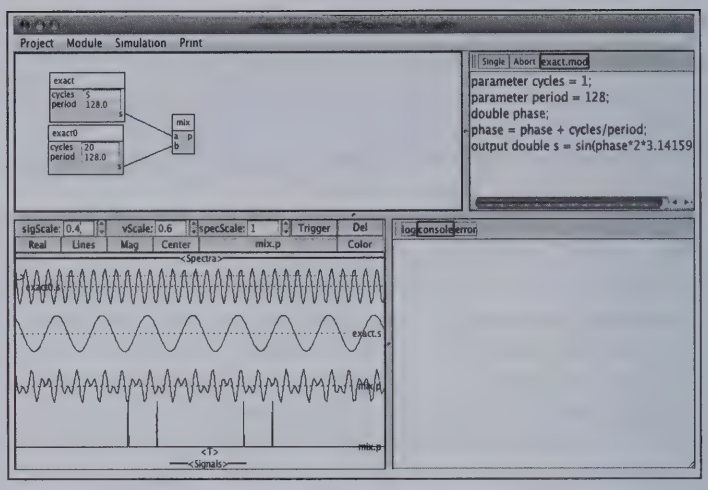


Figure 4—Generating and mixing two signals.

shows how we can use parameters to provide some constants to the compiler. Notice how the 'parameter' initial values are reflected on the schematic. Of course, the value on the schematic can be altered… that is the whole point!

This variable can only be a 'double' and is declared as:

```
parameter double aparam;
```

Note that a 'parameter' is a compile time variable. Changing the value on the schematic will halt simulation and cause the module to be recompiled.

One final thing about variables… variable declaration can be combined with assignment. This is really just a typing shortcut but can prove very useful. You already saw this in the 'first.mod' program shown in Figures 1 and 2. This assignment should not be confused with 'initialization', the assignment is executed every time the module is called.

Hold on here, we'll write a program in a moment.

Multiple Modules

You can create new modules at will. DSPExplorer will maintain text files corresponding to each of the modules. Additionally, DSPExplorer will maintain a text file which contains the state of the schematic and scope panes. Let's create the two modules shown in Figure 3. The first module will simply take two parameters and construct a 'complex' output. The second module will compute the magnitude complex number and print out the result.

To run the program in Figure 3 simply click on "Simulation" and "Single". We use "Single" because we want to execute the program only once. If you hit "Run", DSPExplorer will continuously execute the schematic until you hit "Abort" or "Halt".

The source code for "second.mod" is:

```
parameter double r = 1;
parameter double i = 0;

output complex o = complex(r,i);
```

Note how the complex output is constructed using a call to the function "complex(r,i);". No magic here, DSPExplorer simply takes two doubles and creates a complex number, then assigns the number to the 'o'.

In 'magphz.mod' we show how to take apart complex numbers. The 'real()' and 'imag()' functions do the obvious thing. We then use a 'println' to show the arguments and the results.

One very important characteristic of DSPExplorer is shown in the result of the println. Specifically, the result of the sqrt() function is a complex number which is denoted by the "{5,0}". Indeed, essentially every function provided by DSPExplorer returns a complex value. When you assign a complex number to a double, the double takes on the value of the 'real' part of the complex number. Thus:

```
double r = real(in);
```

could have been written:

```
double r = in;
```

A Simple DSP Example

We've now seen enough of DSPExplorer to write a useful demonstration program. You can follow along in Figure 4.

First, let's write a more sophisticated signal generator which will create an exactly periodic signal. Let's modify 'first' so that it will take two parameters which will control the frequency of the output sin wave. We'll call this module 'exact':

```
parameter cycles = 1;   //how many cycles in a period.
parameter period = 128;   // how long  the period is.

double phase;
phase = phase + cycles/period;
output double s = sin(phase*2*3.14159);
```

Then, let's write a program which will mix two inputs. This module will be called 'mix'. Mixing, of course, is simple multiplication:

```
input double a;
input double b;
```

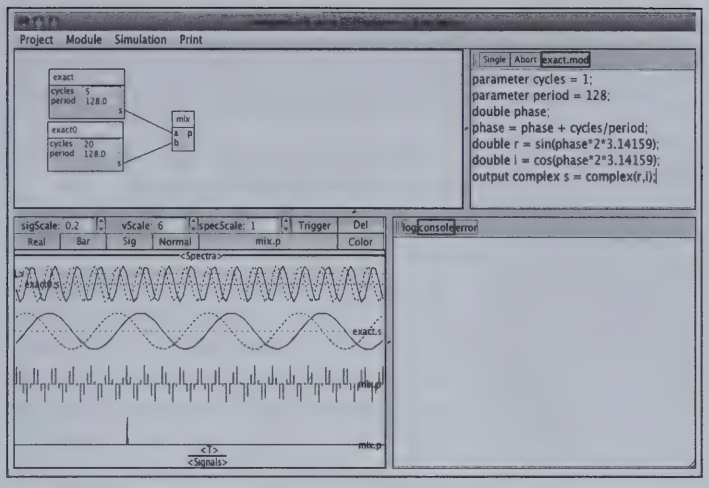


Figure 5—Mixing complex signals.

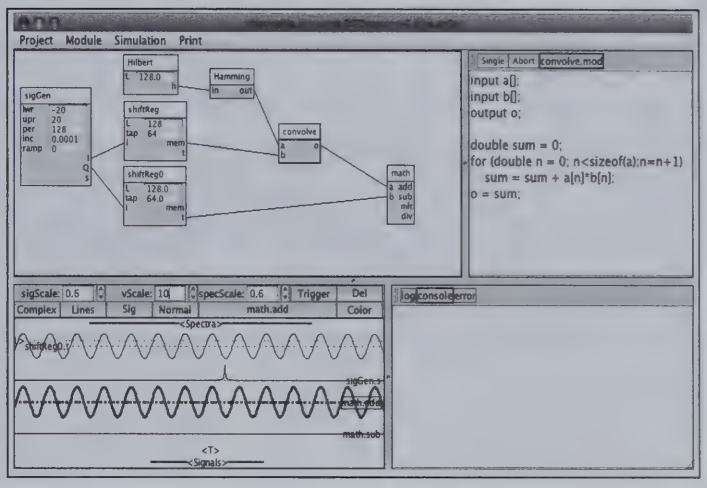


Figure 6—Components of a simple phasing USB generator.

output double p = a*b;

Figure 4 shows the result of the mix. Look closely at the 'scope' section of the figure. I have displayed the two inputs and the mix signal as normal oscilloscope type traces. Additionally, I show the spectrum of the 'mix' signal. As expected, there is a spectral component at the sum and at the difference of the two input signals. Note that because the signals are 'real' signals, there is a 'positive' and a 'negative' frequency component to each signal… a total of four peaks.

As another DSP example, let us see what happens when replace all the variables in 'exact' and 'mix' with complex numbers. Exact is now:

```
parameter cycles = 1;
parameter period = 128;
double phase;
phase = phase + cycles/period;
double r = sin(phase*2*3.14159);
double i = cos(phase*2*3.14159);
output complex s = complex(r,i);
```

In Figure 5 the exact.s and exact0.s signals are displayed as 'complex' traces; the real part is a solid line and the imaginary part is a dotted line. Note now that the spectrum of the 'mix' signal now has just a single peak. This is what happens when we mix 'complex' or 'analytic' signals rather than 'real' signals. (An 'analytic' signal is the same as the familiar 'I/Q' signal seen in most SDR down converters.)

The raggedness seen on the traces in Figure5 are the result of digital sampling of the ideal waveform. To see what the 'software' sees, DSPExplorer allows you to display a signal as 'bars' rather than as 'lines'. The 'mix.p' signal in Figure 5 shows just such a display.

A Complete DSP Example

A complete exploration of all the capabilities of DSPExplorer is far beyond the scope of this short paper. Still, it is useful to see an example most of us can relate to. For this application I chose to show the components of a simple phasing rig. The DSPExplorer screen is shown in Figure 6.

In this example, my input is a more generic signal generator called 'sigGen'. SigGen generates an I/Q pair. It continuously sweeps the frequency starting at the 'lwr' frequency and working its way up to the 'upr' frequency and then back down. By adjusting the 'inc' value, the sweep rate can be adjusted. The 'ramp' signal allows one to shape the amplitude of the signal as a function of frequency. I don't use this feature here which is why it is '0'.

The output of the sigGen is essentially what would come from the familiar I/Q down converting mixer. As you can see, the 'Q' channel passes through a shift register (shiftReg). The effect of the shift register is to simply delay the signal by 64 samples. This is used to compensate for the delay in the 'I' path.

The 'I' path is where most of the processing takes place. The I channel is buffered using the shiftReg module. The shift register is 128 entries long to match the length of the Hilbert Transform. The 'mem' output of shiftReg is the array of samples.

The Hilbert block generates a Hilbert Transform kernel which is 128 samples long. The purpose of the Hilbert Transform is to provide a phase shift of 90 degrees for every frequency. This kernel is passed through the Hamming window function. The Hamming window will reduce the ripple introduced by Hilbert Transform.

The work is done in the 'convolve' block. In essence, the convolve block computes the dot product of the two input vectors. The code is shown here:

```
input a[ ];
input b[ ];
output o;

double sum = 0;
for (double n = 0; n<sizeof(a);n=n+1)
    sum = sum + a[n]*b[n];
o = sum;
```

This function is such a common operation that DSPExplorer provides a builtin in function to simplify the coding. The for loop above could be written "o = dot(a,b);".

The output of the convolve block is the I channel with a 90

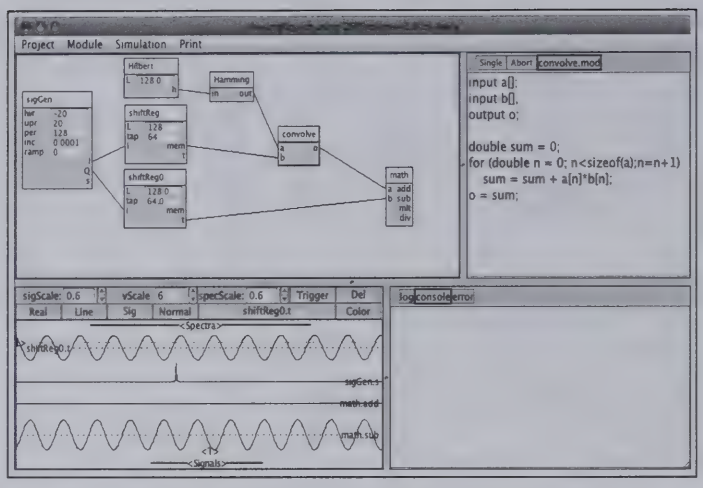


Figure 7—Similar display for phasing LSB generator.

degree phase shift applied. The upper and lower side bands are then easily computed. The upper sideband is the sum of the delayed Q and Hilbert Transform of I. The lower sideband is the difference.

The scope in Figure 6 shows four traces. The topmost trace is shiftReg0.t which is simply a delayed version of the Q channel. (There was no particular reason for choosing this signal.) The next trace down is the spectrum of sigGen.s. When the peak is to the right of center, the frequency is positive and when the peak is to the left, the frequency is 'negative'.

The next trace down is the math.add or upper sideband. As you can see, there is a signal there since the peak in sigGen.s is on the right hand side of the screen. The bottom trace is math.sub which is the lower sideband. Math.sub is a flat line indicating that there is no signal on the lower sideband of sigGen.s.

As sigGen sweeps the frequency up and down, the upper and lower sideband signals alternate indicating that the phasing rig is working properly. For completeness, Figure 7 shows a lower sideband signal.

Other Experiments

DSPExplorer has been used to examine a wide range of DSP applications. A few are listed here:

- Demonstrate the effect and utility of various windowing functions.
- Show how Quadrature Error Correction can be done.
- Demonstrate alternate phasing architectures which don't use the Hilbert Transform.
- Explore implementations of Digital Automatic Gain Control.
- Demonstrate different ways Window kernels can be generated.
- Show how using the FFT and inverse FFT can replace the Hilbert Transform and the convolve function.
- Demonstrate how to use the FFT and the IFFT to perform more precise spectrum analysis.
- Demonstrate up and down conversion using decimation rather than multiplication.
- Demonstrate other filter techniques such as Frequency Sampling, Comb, and Infinite Impulse Response filters.
- Show how the Sliding DFT and single frequency detector function.

Summary

When I started to try to learn about Software Defined Radio I found that there was no easy way to verify my understanding without actually writing programs. But when I started to write programs I found myself lost in the intricacies of programming inputs, tests, and graphing outputs. When I went looking for a better way, I found none and I was driven to develop an Integrated Development Environment. The hope was that the IDE would provide a generic framework for DSP program development and that this generic framework would allow me to concentrate on my programs. DSPExplorer was born.

DSPExplorer is a fairly comprehensive framework for developing DSP software techniques. It allows the user to generate nearly any test signal simply by writing a program to generate the signal. Blocks of DSP code can be written in a C-like language and connected together using a simple schematic capture tool. All program variables can be displayed in 'time' or in 'frequency' using a simple 'oscilloscope'. DSPExplorer is completely self contained and requires no external hardware or software to operate. It will operate on any system which supports Java.

My hope is that by providing a self contained development environment I can entice the reader to try writing a few DSP programs. Nothing teaches like doing, and DSPExplorer makes doing so much easier! I urge you to download it at www.ae6ty.com and give it a try.

Notes

[1] Excel is Microsoft Spreadsheet calculator much like Numbers from Apple. Both Excel and Numbers are, undoubtedly, trademarked.

■■

Oleg "Mr. 72" Borodin—RV3GM rv3gm@mail.ru

Visit to sweet Hawaii

Last September I with my wife Olga (RA3GKB) visited Big Island, Hawaii. Our old friend Dean Manley KH6B and Big Island ARC invited us to have a fun holiday devoted to our 30th wedding anniversary at the Earth Paradise place. Almost 2 days flight with night at Los-Angeles hotel was not such an easy way.

First of all, BIARC ask me to talk about any features of Russian QRP. I choose a good theme for sunny Hawaii and told about Russian Winter QRP Field Games "Moroz—the Red Nose." I created a nice Powerpoint presentation of pictures from the event, and narrated it from memory.

I did this same presentation for the Hilo ARC, as they were celebrating their 69th anniversary. The presentation seemed to be of interest to all the Hawaiian hams present, and not just the QRPers. They asked me a lot of any questions about Russian winter, portable equipment and antennas and everybody enjoyed looking one of my pictures with FT-817 inside a felt boot protected, protected from the freezing weather.

Big Island amateurs have a nice tradition. For the last 17 years they have been meeting at the Jack in the Box café every morning! Of course, Olga, Dean, and I took a part in the daily morning coffee.

On September 1st, Dean KH6B prepared a micro QRP expedition to Moku Ola (Coconut) Island near Hilo bay. He brought his Elecraft-K1 with battery pack and 20 m inverted Vee with a 20 foot fishing pole as a support. Dean generously permitted me to use special Moku Ola Island call sign ALØHA during the Spartan Sprint. I heard a lot of US QRPers at 14060 kHz and even my friend Oleg UR5FA/MM in the Caribbean. To my dismay though, Oleg did not copy my 5 watts call and only asked "QRZ? ALØ???"

About six months before our trip to Big Island, I asked Dean to find me a place to sit for my FCC exam. I had spent a lot of time learning the exam questions at ARRL HAM test online Web Page. Much to my surprise I now hold an Extra-class license and hope to get my new call sign KH6OB soon. That's a great honor and pleasure for me indeed.

Oleg RV3GM and Olga RA3GKB at Big Island, Hawaii

"Moroz—the Red Nose" presentation at the BIARC meeting.

FT817 protected from freezing in the felt boot.

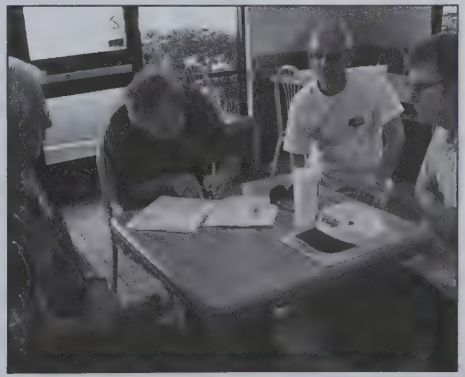
RV3GM and KH6B meet at the Jack In the Box.

Our next plan is a special QRP expedition to Moku Ola Island (IOTA OC-019), Laupahoehoe Point Beach (Big Island, Hawaii) and to Marshall Islands in July 2012. We will offer thanks for any possible donations and help for this QRP expedition.

In these *QRP Quarterly* pages I'd like to thanks all my Hawaiian friends. Personally thanks to a couple of Barbara and Richard Darling (NH7FY and AH7G), to Paul WH7BR (President of BIARC), to Dean Manley KH6B (President of Hawaii QRP Club), to Ben Blatt "Big Ben" NH7D, to Paul KH6HME (Great UHFer!), to Max KH6ZM (Great Contester and DXer). Thanks to all for their hospitality and friendship. The great ALOHA! No doubt, we meet soon again.

(See more photos of the visit to Hawaii on the next page.)

Micro QRP expedition ALØHA to Moku Ola Island.



My FCC exam and rigorous VEs Dean KH6B, Russ KH6JRM, Scott KH6AVF.

The warmest company (L to R): Oleg RV3GM, Barbara NH7FY, Richard AH7G, Dean KH6B, Ben NH7D, Dave KH7SO.

Max KH6ZM and Oleg RV3GM

"Look To the Horizon" QRP Marathon

Last December 2010 QRP Radioclub "72" International organized an experimental QRP Marathon named "Look To the Horizon". 24 Russian QRPers tested the Marathon rules and enjoyed a new QRP game.

The general purpose of the Marathon is increase QRP and QRPp activity, use of WW-locators and the lowest usable power. To estimate the value of the "reference distance" of the QSO, both power of the transmitter and the receiving station were also used.

The Marathon is scheduled twice per year in April and October. All QRP operators of the world welcome. Here are the main rules:

- Use only the following modes: CW, SSB, PSK, MFSK, Olivia-500.
- All HF bands 10M to 160M including WARC.
- Participants may use QRP power only.
- Only 1 QSO per day (by UTC) may be submitted.
- Choose the best resulted QSO.
- Each station may be submitted once only, regardless of bands or modes.
- Only QSO distance of 500 km or more may be submitted.
- Only WW-locators may be used for distance calculation.
- For reference distance of QSO new unit of measurement used—Luk. The reference distance of QSO calculation formula:

$Z = L/\mathrm{sqrt}(P1 \times P2)$
L: Distance, km
sqrt - square root
P1 and *P2*: both stations powe (watts)
Z: Reference distance of QSO, *Luk*

- Results of each participant are accumulate separately by the bands and totaled.
- Winners by bands results.
- Champion determined by sum of total bands results.

Thanks to W1REX and R4NX for prize sponsorship! For any questions, contact mr72@club72.su. See the complete Rules at www.club72.su

QRP Top-lists

When this was written, there are the following QRP ratings at the Club "72" Web page:

- QRP DXCC Top-list (leaders DJØGD, SM5LWC, OM3CUG)
- 2-way QRP DXCC Top-list (RV3GM, GM3OXX, HB9DAX)
- QRP WW Sectors / Grids Top-list (HB9DAX, SM5LWC, RX3DOR)
- 2-way QRP WW Sectors / Grids Top-list (HB9DAX, DJØGD, RX3DOR)

Each QRP operator may send their results in to the Top-lists using a special online form at the lists pages. Welcome!

Daily QRP "Rendezvous"

At 10 UTC a lot of European QRPers active at 14060 kHz in so called "QRP Rendezvous". The inhabitants here are well known QRPers as HB9DAX, DJØGD, VK4TJ, RA1AIF/mm, F5UKL (1 watt), OH9VL (700 mW), UA1OKO, OK1HB, UU7JF etc. On weekends when there are large contests, 18096 kHz is the place for the "rendezvous".

That's all folks! Send me your news and see you on QRP frequencies.

—72! Oleg, RV3GM

●●

International QRPers!

Send news about your clubs and your personal QRP activities to Oleg at:

rv3gm@mail.ru

Workman 40M Antenna Stick 3-Band Conversion

Ed Breneiser—WA3WSJ wa3wsj@arrl.net

I just love to operate pedestrian mobile from anywhere I can hike, drive, bike, ski or crawl. So I put together a very nice Icom 703 Plus HFpack (Figure 1).

Figure 1—HF backpack for pedestrian mobile (pm) operation.

I did have one self-imposed limiting prerequisite—the counterpoise drag wire could not be any longer than fifteen feet. I have found that a longer drag wire just gets caught on to many objects around me as I walk through brush, cars etc. I also did not want change my drag wire for each band and carry the wires around as I walk the countryside etc. One counterpoise wire for 20m, 30m and 40m is a must for me.

I decided to use Workman Antenna Sticks because they are cheap at around $13 each and lightweight. But, I needed to change antenna sticks every time I wanted to operate on a different band. Having this restriction, severely limited how far I could walk away from my truck as this is where I have the other antenna sticks.

I then took a Workman 40M Antenna Stick and proceeded to add turns on the top loading coil for 40M CW (Figue 2). After tuning the stick for CW, found that it needed approximately fifty additional turns of wire to resonate at around 7.100 MHz. I suspect that the added turns were needed due to the short counterpoise wire. By adding the extra turns, I now can operate the 40M band from 7.030 to around 7.150 MHz. Since I operate mainly on CW, this portion of the band is fine for me.

Next I proceeded to install taps on for the 30M and 20M bands. Hoping to have one antenna stick for 40M, 30M and 20M and only have to move a jumper to change bands on the antenna. After finding the tap points for 30M and then 20M, I installed small loops so I can attach a jumper wire to change bands. To form the jumper loop I used large paper clip wire to form the loop and then soldered it to the coil wire.

Here's where the taps ended up on the stick. Starting at the top of the coil section, I placed my top jumper 4.5" down. This is after I added 50 turns on top. My 30M jumper is 17.75" down from the top jumper. The 20M loop ended 22.50" down from the 30M loop or 2.25" up from the bottom of the antenna loading coil (see Figure 3).

The overall length of the Workman 40M HF Stick Antenna is 7' 10". I measured the height above ground or HAG to be about five feet. This is where the stick attaches to my ALICE Frame which is on my back. This means the top of the antenna is almost thirteen feet above ground level. I tried to stay around ten feet, but this is the lowest I could get without additional loading and further compromising antenna performance.

My counterpoise drag wire measures 14' 9" and is just about the proper length to use to hike around here in Pennsylvania. Again, If you try to use a 33 foot drag wire, be aware that you'll need wide open spaces with few or no obstructions in your walking-path. Just walking by a parked-car will present a problem with a thirty-foot drag wire as the wire could easily get caught under a tire –HI!

This brings up a good point. Make sure your drag wire can pull away from the ground connection! If your drag wire gets caught, you want it to pull off the pack etc. I use an alligator clip to attach my drag wire to the ALICE pack. I've had it pull off only a few times, but it saved the wire from breaking off!

So, after finding the resonate point of 7.085 MHz on 40M, 10.100 MHz on 30M and 14.125 MHz on 20M, I installed my loops on the loading coil. I could have found closer resonate points to where I want to operate, but these are close enough

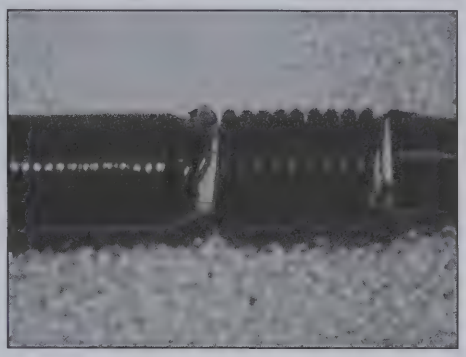
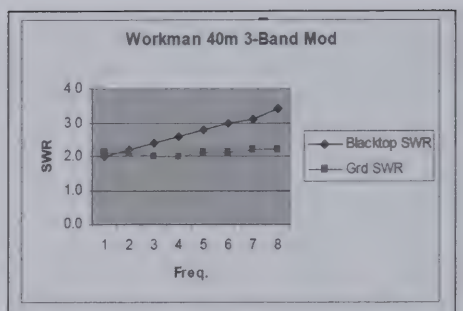


Figure 2—Closeup of the additional loading coil winding and connections.

Figure 3—Left: Jumper connection method; right: Finished antenna with jumper in place.

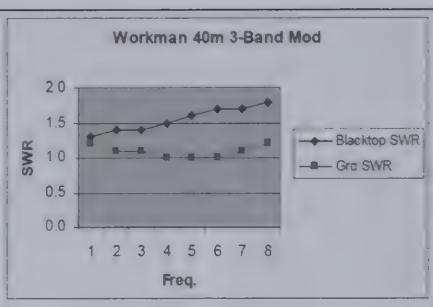
for me. So, how much bandwidth do I have to operate on these three bands? Well, that seems to vary according to what type of material you are walking on –HI!

For testing purposes I used only two types of materials. I usually walk on blacktop or ground so these are the two ground materials used for my testing. On 40M, 30M and 20M bands it appears that actual ground, that is soil with grass on top seemed to work best. Look at Figures 4, 5 and 6 for the charts of each band tested list-



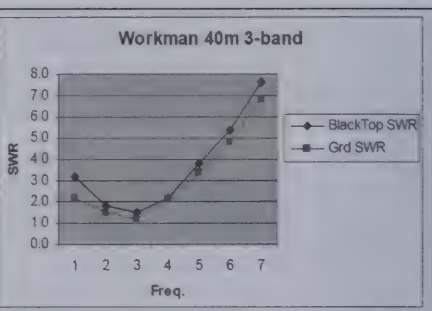
	BlacTop SWR	Grd SWR
14.000	2.0	2.1
14.050	2.2	2.1
14.100	2.4	2.0
14.150	2.6	2.0
14.200	2.8	2.1
14.250	3.0	2.1
14.300	3.1	2.2
14.350	3.4	2.2

Figure 4—20M performance chart.



10.100	1.3	1.2
10.110	1.4	1.1
10.120	1.4	1.1
10.130	1.5	1.0
10.140	1.6	1.0
10.150	1.7	1.0
10.160	1.7	1.1
10.170	1.8	1.2

Figure 5—30M performance chart.



7.000	3.2	2.2
7.050	1.8	1.5
7.100	1.5	1.2
7.150	2.2	2.1
7.200	3.8	3.4
7.250	5.4	4.8
7.300	7.6	6.8

Figure 6—40M performance chart.

ing frequency vs SWR on blacktop and dirt covered with grass.

I did try this antenna with the same counterpoise wire on my Elecraft KX1 Backpack (Figure 7) with excellent results. On 20M I had 3.5 W @ 1.0:1 SWR. On 30M I measured 3.8 W @ 1.0:1. Finally on 40M, where I thought I might have a problem, I had 4.2 W @ 1.0:1! This is using the internal antenna tuner of my Elecraft KX1.

For this pack I just put together a 3/4" PVC pipe frame, as shown in Figure 8. The center PVC piece has an old green military steel copper-coated rod inserted in it. On top I hammered on a quick disconnect fitting into the steel copper-coated old military rod. I then soldered a wire to the rod at the bottom and attached it to a panel mount BNC connector.

The whole PVC frame can be taken apart for air travel etc. This allows me to take my Elecraft KX1 HFpack anywhere! I did not glue any of the PVC pipe pieces together at all as they seem to work just fine pushed together and then inserted in the backpack. I also may now take additional items with me while I walk or hike around as there's plenty of extra room in the pack.

Figure 9 is a look at the top of the pack. The quick disconnect fitting is threaded, but I just used a soft hammer to pound this fitting down into the rod. I now can just push and twist to insert or remove my antenna. This whole HFpack is very light and I even made a belt mount for my KX1 Radio so it is located right in front of me. This is hands-free operation concerning the radio. I just hold my Palm Paddle in my hands—it's great!

To use my KX1 pedestrian mobile without holding it all the time, I engineered

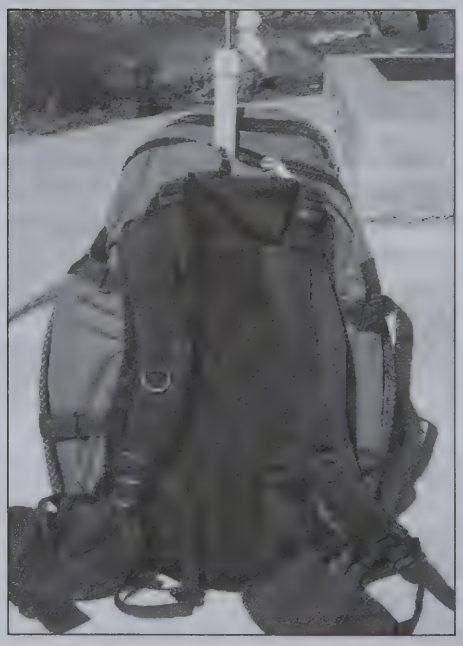


Figure 7—Backpack designed to use with the KX1.

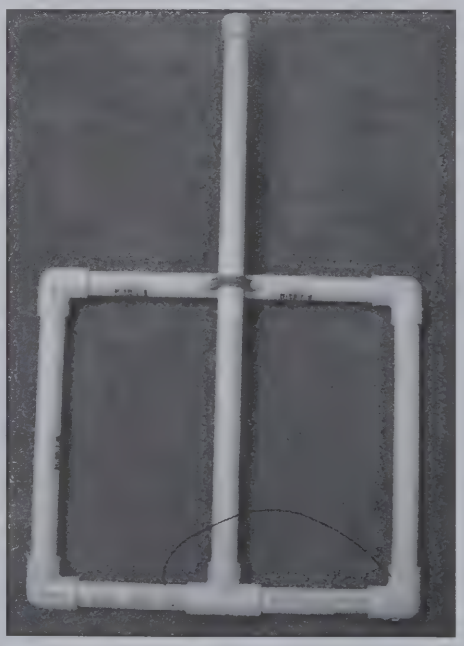


Figure 8—PVC frame that supports the antenna.

Figure 9—Closeup of the quick-disconnect antenna mount.

a cheap, but effective assembly I call my "KX1 Home Depot Belt Mount," illustrated in Figures 10 and 11. This device just clamps on my backpack waist belt and it places the KX1 radio at approximately three inches above my waist. This is a very convenient spot as the radio is right there in front of you. Here's what it looks like from the side.

Figure 10—Front view of the KX1 attached to the belt mount.

Figure 11—A look at the "KX1 Home Depot Belt Mount".

Please note this assembly is nothing more than two yellow paint clamps purchased from Home Depot for $3.00 each. The clamps are attached or bolted to a cheap scrubbing-pad purchased from Home Depot for $1.96. I then bought two 1" × 4/40 bolts and soldered them into the brass knurled-knobs I bought at Home Depot. The assembly simply clamps onto my pack waist belt.

●●

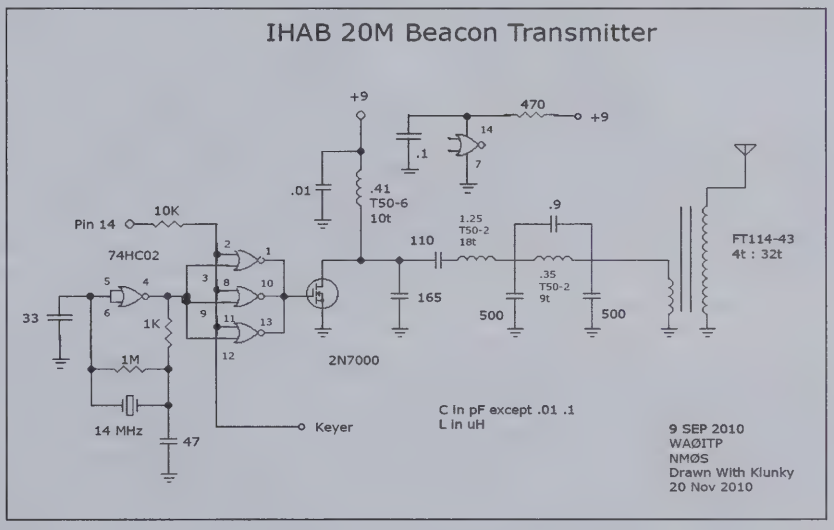
Article Update—

"Iowa High Altitude Baloon Project," *QQ*, Winter 2011

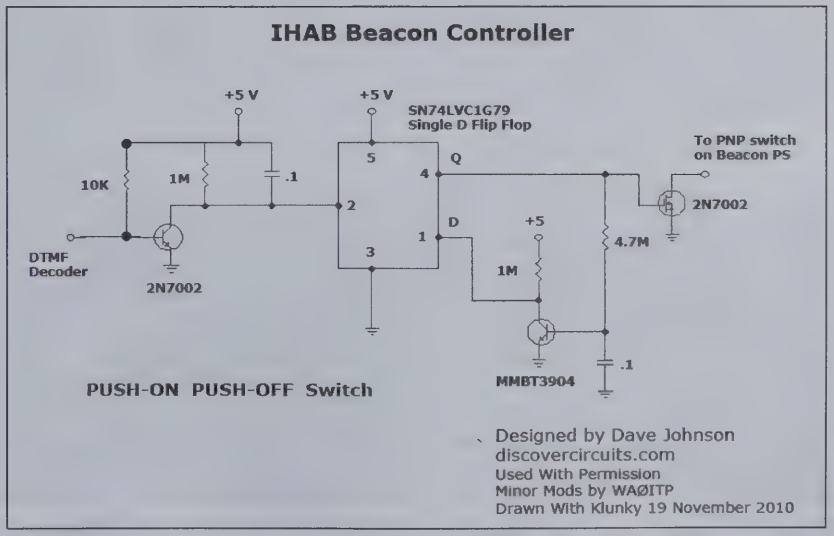
Brian, KB9BVN:

I had to make some changes to these two figures from the article. In Fig. 2 the input bipolar transistor was changed to a MOSFET and a pull-up resistor was added for more reliable operation. In Fig. 6 the toroid cores were misidentified in the original schematic. They are T50-2 toroids. Thought you might want to include them in a future issue. *—72 Terry, WAØITP*

Updated Figure 2:



Updated Figure 6:



Another Approach to Slowing a Bug

Richard Meiss—WB9LPU igeq100@iupui.edu

The speed of a conventional semi-automatic telegraph key (a "bug") is determined by the interaction of several physical factors. They are: the mass of the weight on the pendulum; the position of the weight along the pendulum (equivalent to changing the pendulum length), and the stiffness of the flat spring that provides the restoring forces. There have been a number of clever devices to accomplish the first two actions, some of which, like the Bug Tamer, have been commercially available, and a number of which have been described by their developers in various publications. And some operators, often to their later regret, have filed down the spring to weaken it and thereby slow the bug. This latter approach is not easily reversible, because the spring is generally riveted into place. The weakened spring also provides less vertical support for the extended pendulum.

An Alternative Approach

There is another approach to reducing speed by lowering the stiffness of the spring; it is a little more complicated to construct but it is easy to adjust and works well. Recall that when two springs are placed in parallel mechanically, the overall stiffness is the sum of the individual stiffnesses (as in an automobile leaf spring). If one of these springs is a "negative" spring, however, the stiffness of the combination is less than that of the original spring. But where does one obtain a "negative" spring? The simplest way to do this is to use permanent magnets arranged so that their repulsion counteracts the action of the original spring.

In Figure 1 (upper left), two permanent magnets are held facing each other at a constant spacing, with their poles arranged to produce repulsion. One is fixed in position, and the other can move laterally (but not up-and-down). As the magnets approach axial alignment, it requires increasingly more force to move the magnets to the same axis. The force curve produced is very non-linear. At the upper right, the characteristics of a flat spring (as used in a bug) are diagrammed. This is a linear spring, with the force directly related to the displacement. If the magnets and the spring are arranged so the displacements can "add together" in the proper way, a situation like that in the lower left can be produced. This curve has regions of both positive and negative stiffness. If the proper region is chosen, the flat spring is effectively made less stiff, and a bug using this arrangement will go slower for a given mass. If the vertical separation between the two magnets is increased, the displacement effect is reduced, and the oscillation rate will be increased.

Using a screw-thread mechanism to vary the spacing allows for convenient control of the speed without having to move the pendulum weight. For an extended range, however, the weight can also be moved, and then the system works as an unmodified bug.

Practical Considerations

For this system to work, one magnet (termed "fixed") must be mounted on the near portion of the bug lever, before the leaf spring. The second magnet must be mounted on the pendulum rod, just after the leaf spring. This places the magnet pair effectively in parallel with the leaf spring. So that no permanent changes are made to the bug, both parts are mounted with clamps or setscrews.

The diagram in Figure 2 shows what happens as the pendulum moves back and forth. At position "A" (at the center, or "equilibrium" position), the magnet force is balanced by the spring force. Notice that the magnet arm is offset slightly so that the magnets are positioned in the proper position along their repulsion curve (see first figure). As the pendulum is moved to the left (position "B") by the inertia of the weight, the magnetic force lessens, while the spring force increases until the pendulum stops. The spring force will then accelerate the pendulum back to the right

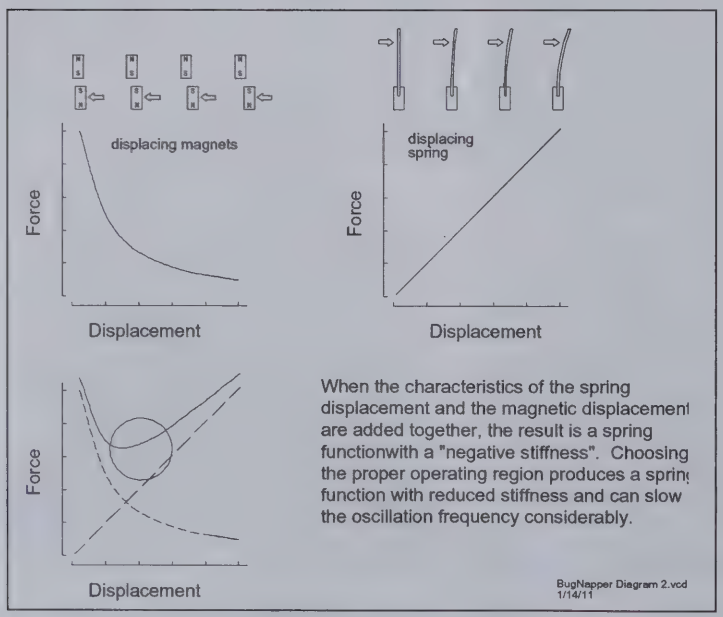

displacing magnets
Force
Displacement
displacing spring
Force
Displacement
Force
Displacement
When the characteristics of the spring displacement and the magnetic displacement are added together, the result is a spring functionwith a "negative stiffness". Choosing the proper operating region produces a spring function with reduced stiffness and can slow the oscillation frequency considerably.
BugNapper Diagram 2.vcd
1/14/11

Figure 1—Magnet and spring actions.

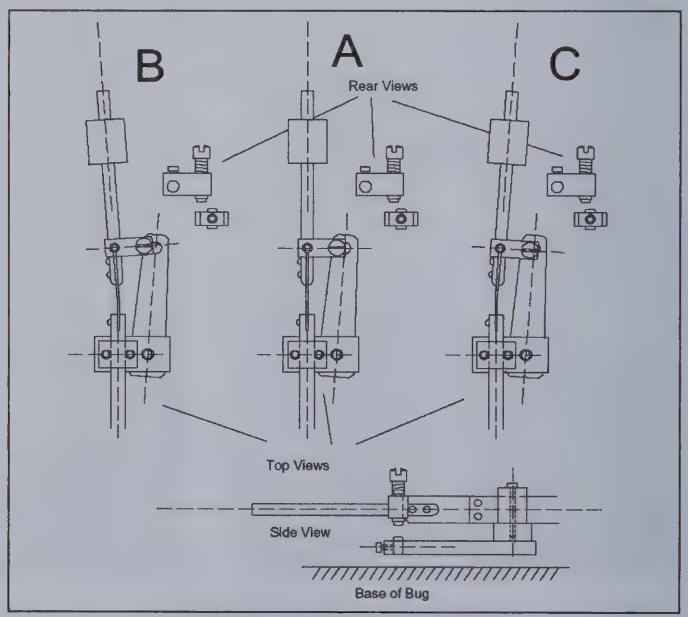


Figure 2—Pendulum movement.

(C); as it moves, the magnetic force (and then the spring force) retards the motion, and again the pendulum swings back. The net effect of the "negative stiffness" of the magnetic interaction is to cause an oscillation at a lower rate than with the leaf spring alone.

The Hardware

Shown in Figure 3 is the first practical attempt, which is BugNapper II (see Appendix for comments about version I).

The Parts of BugNapper II.

The device is made mainly of aluminum, with brass magnet holders. When it is assembled, the fixed arm and its magnet attach to the bug lever, while the pendulum magnet mounts to the base of the pendulum rod, up against the end of the leaf spring of the bug.

So that no modifications to the bug are necessary, the upright support of the BugNapper (which carries the fixed magnet) attaches to the lever of the bug with a clamp mechanism. This fits exactly to the lever and is secured by a flat plate attached by three screws. When these screws are slightly loosened, the assembly can be slid forward or backward to align the two magnets. The clamp approach was taken to prevent damage to the bug which could be caused by a set screw fixed mounting. The fixed (upper) magnet is mounted in a brass screw to which a short lever arm (fixed magnet adjuster) is attached. This allows the magnet separation to be varied in order to control the speed of the bug.

The assembled BugNapper is ready to be attached to the lever assembly of the bug (Figures 4 and 5). It is important that this mounting be very secure, with no lost motion.The key has been disassembled for purposes of illustration. However, the design of the BugNapper is such as to allow its attachment without taking the bug apart.

Detail of the mounted BugNapper are shown in Figure 6. The fixed magnet arm is attached to the top of its support by a single screw so that the position of its magnet can be changed relative to that of the pendulum magnet. The magnets must not be coaxial—the proper position is such that the magnetic interaction is causing the pendulum spring to bend in the direction of the U-spring contact. This insures that the magnetic interaction will effectively

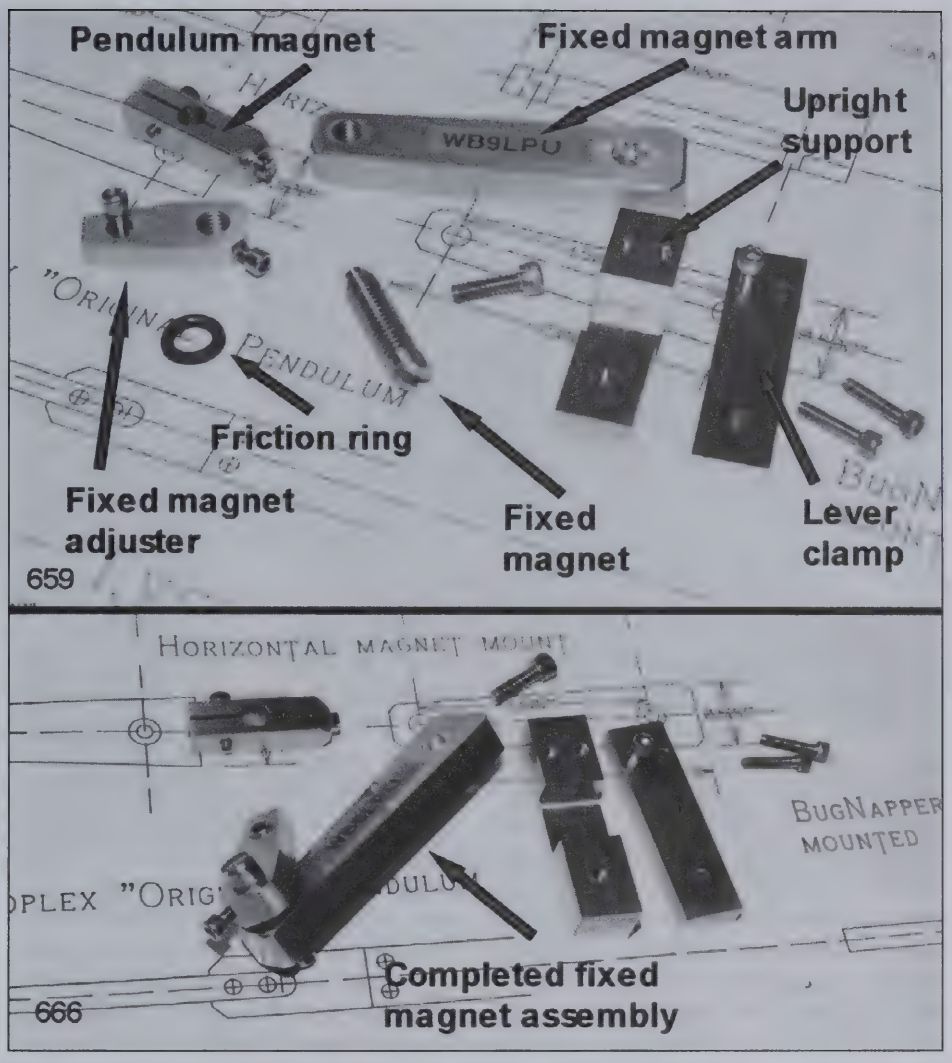


Figure 3—The parts of BugNapper II.

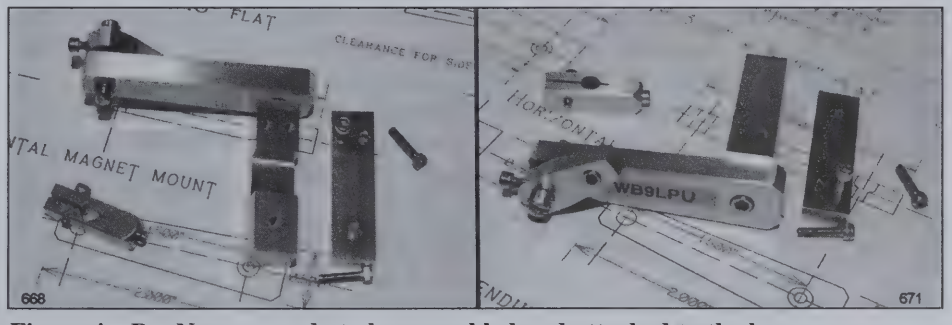


Figure 4—BugNapper ready to be assembled and attached to the lever arm.

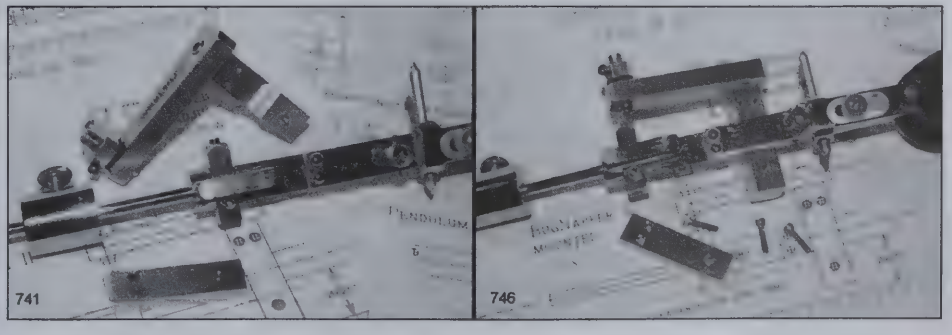


Figure 5—BugNapper attachment to the bug's lever arm assembly.

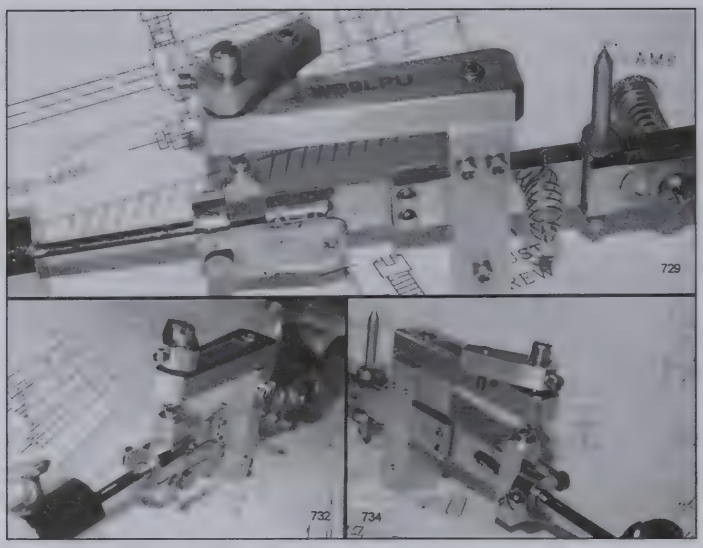


Figure 6—Details of the mounted BugNapper.

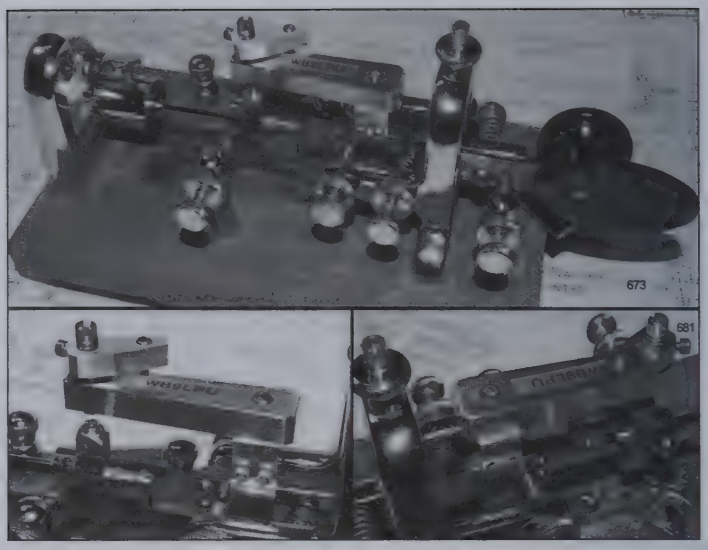


Figure 7—Properly mounted lever assembly.

"weaken" the spring.

Finally, the lever assembly is shown mounted in its proper position in the bug (Figure 7). With the large Vibroplex weight shown, the unmodified bug has a slowest speed of 21 words per minute (wpm) and a fastest speed of 32 wpm. Setting the BugNapper II to its most extreme position yields a speed of 9 wpm, and a full movement of the speed adjuster allows a speed of 12 wpm. Moving the weight to the fast position increases the speed to 16 wpm. These ranges can be modified by more specific adjustment of the magnet offset described above.

The speeds mentioned above were calculated as follows. The basic timing element of a Morse character is the "dot." A dot is followed by a space of the same length, and a "dash" is three dots long (and is followed by a one-dot space). The between-character spacing is two dots long. With this scheme, the word "PARIS" is the standard-length word. That is, if the word PARIS is sent 15 times in one minute, the code speed is 15 wpm. From the above definition of relative dot, dash, and space lengths, it can be shown that the speed in words per minute is equal to 2.4 times the number of dots per second. The computer program Audacity (a shareware program from http://audacity.sourceforge.net) was used to make time measurements by analyzing the recorded output of a code practice oscillator.

In the course of development, a few downsides of this approach were noted (as compared to adding weight and/or length to the pendulum). Each time the pendulum closes the dot contact (via the U-spring), it loses some of its kinetic energy. This eventually limits the length of a string of dots. A swinging pendulum with a large mass at its end contains a large amount of kinetic energy, and this allows for an extended dot-string. If the mass is kept rather small and the leaf spring made more compliant, as is the case with the BugNapper, the pendulum can contain less kinetic energy, and the length of a string of dots is more limited. However, experience has shown that this is not a limitation in practice – very few people use the 8-dit "error sign" anymore, and I don't usually count higher than five.

Another potential problem is the nonlinear behavior of the magnetic repulsion force. This means that adjustment could be rather sensitive. In practice, the use of rigid construction and a fine-thread screw mech-

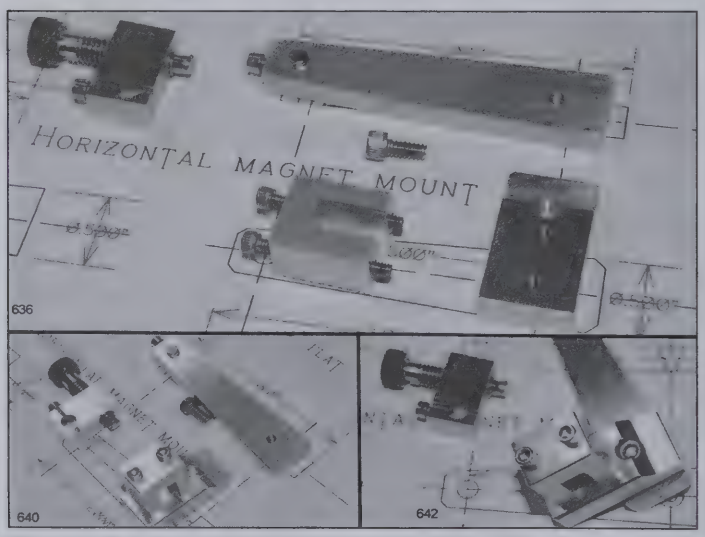


Figure 8—BugNapper III design with over-under parts.

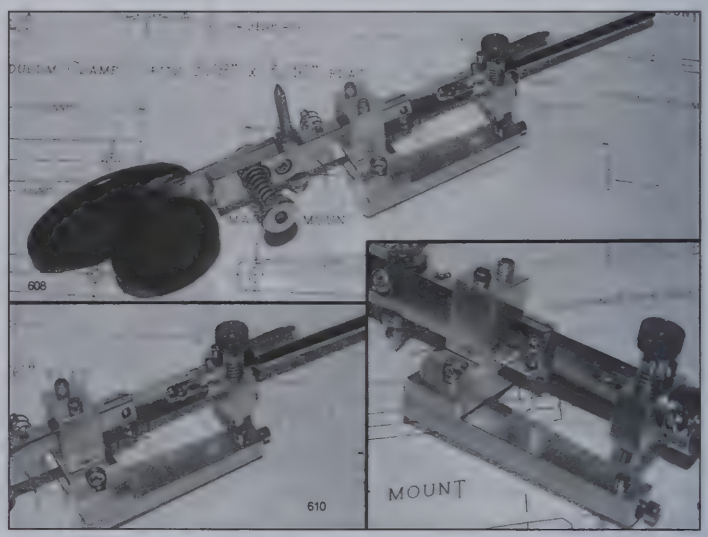


Figure 9—The modified design mounted on the lever.

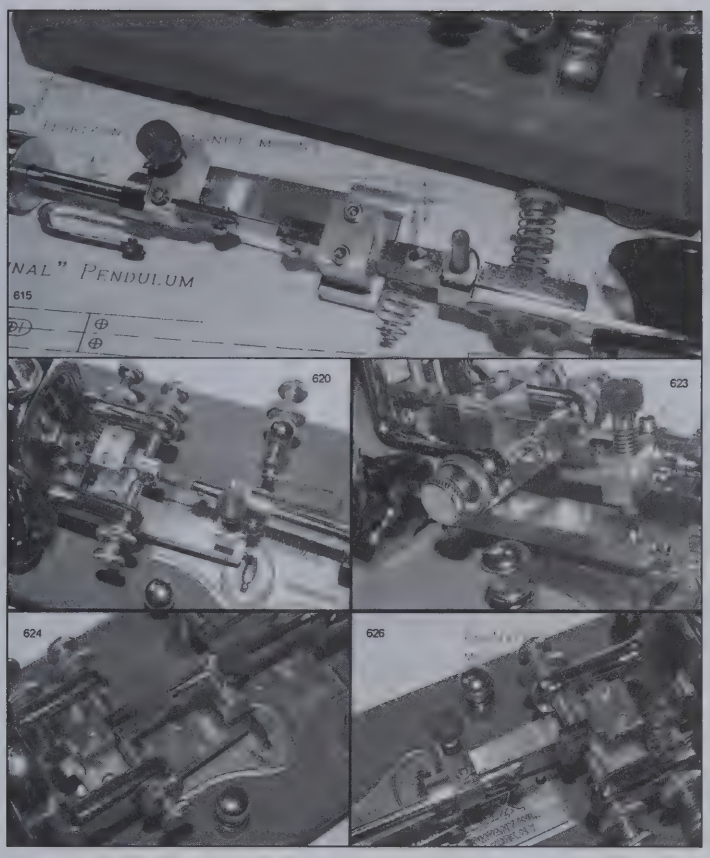


Figure 10—Mounting of the BugNapper III.

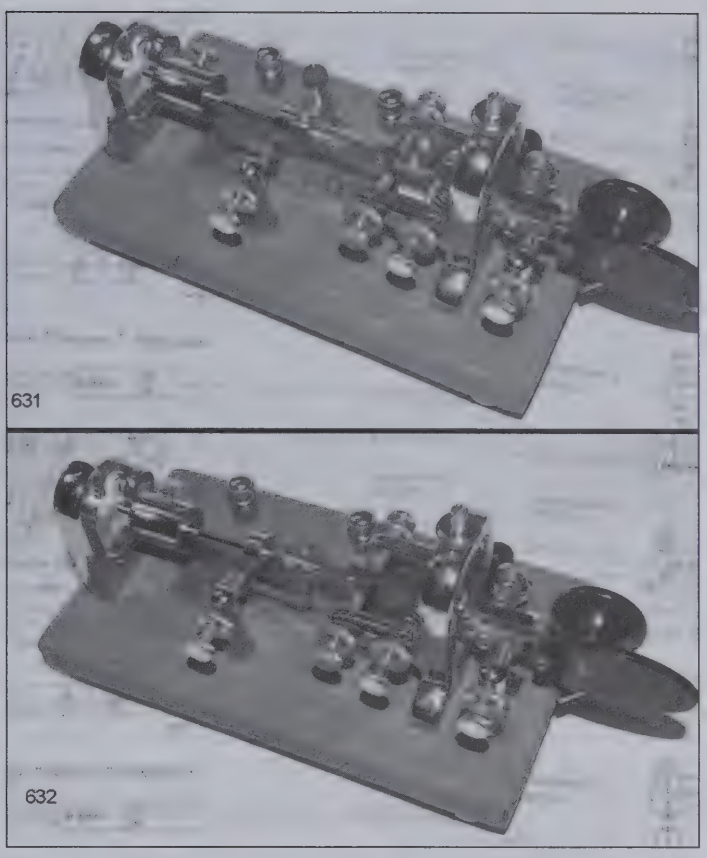


Figure 11—Vibroplex Original before and after installation.

anism have turned this problem into an advantage, making adjustments possible with little movement of the magnet screw.

A Second Try

While the BugNapper II works well, it is rather obtrusive when mounted on the key. To get around this "training wheels" appearance, an under-the-lever design was pursued. This design places the fixed magnet arm beside and below the lever of the bug, while the speed-adjust screw is carried by the pendulum. The parts of this device (BugNapper III) are shown in Figure 8. Again, a clamp device is used to attach the unit to the lever. As before, this attachment allows for careful adjustment of the position of the fixed magnet.

A few complications did arise. There is some variation in the height of the pendulum assembly among Vibroplex Original keys manufactured over the years, and the dimensions of the arms of the bearing support (which bear most of the adjustment screws) are not always the same. The height of the pendulum can be varied somewhat by adjusting the position of the bearing cups (which hold the pointed ends of the trunnion), but this is limited. For this reason, the plate that holds the fixed magnet arm is machined to accommodate these variations and to keep the BugNapper from interfering with the motion of the lever.

Figure 9 shows some views of the device installed on the lever. The magnet arm is attached with a single screw to allow the lateral position of the fixed magnet to be adjusted. To prevent its rotation, the pendulum magnet holder has a vertical slit that engages the end of the leaf spring. This acts as a keyway to maintain the alignment, which is held by a set screw.

While the illustration in Figure 9 shows the lever assembly removed from the bug, the BugNapper can be installed without taking the bug apart, with all adjustments being accessible when it is in place. Speed changes are accomplished by turning the pendulum magnet screw to change the vertical magnet spacing, and the screw that holds the fixed magnet arm is accessible from above. The U-spring maintains its original position, so that the sliding weight on the pendulum may still be used as an additional means of speed control.

The uppermost picture of Figure 10 shows the lever prior to being mounted in the bug, while the lower picture shows the competed installation from several viewpoints.

Some Final Comments

The two views of Figuire 11 show the bug (a 50+ year-old Vibroplex Original with great sentimental value) with and without the BugNapper III installed. Its presence is not obtrusive—the only obvious change is the red adjustment knob and the clamp assembly between the arms of the bearing support.

So here is another approach to slowing down a frisky bug, one that avoids the placing of extra weights or extensions to the pendulum (with the associated inertial problems). It has its advantages and drawbacks, and it will be tested on the air to see what improvements are still needed.

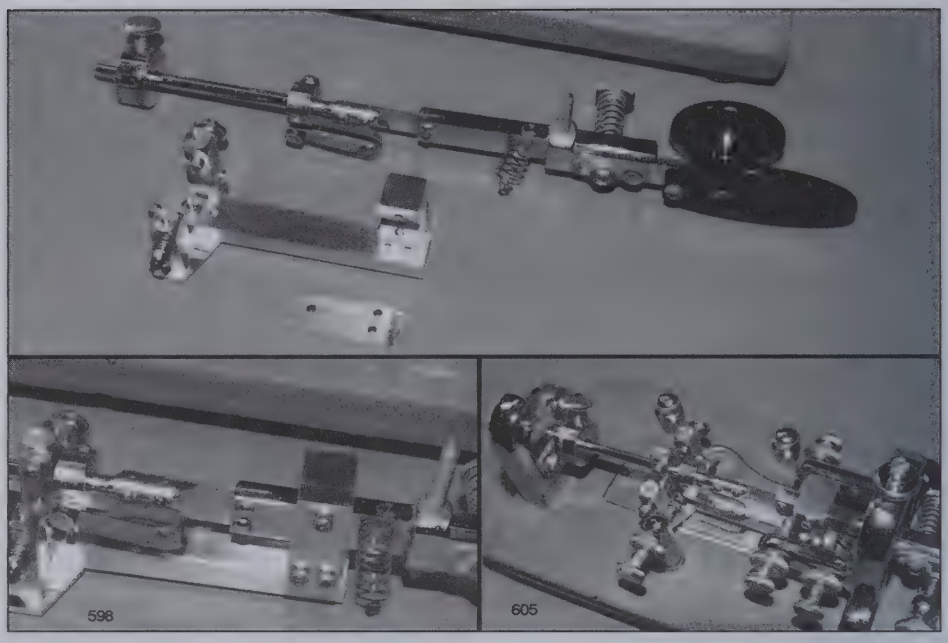
It also brings up the question of "Why slow the bug down? Why not just learn to copy CW faster?" To this I would say that there are those of us who enjoy using a bug on the air and don't wish to strain the copying abilities of the ham on the other end of the QSO. This allows bug operators to widen their scope of operation and perhaps

to share their enjoyment of this beloved anachronism on the air. What could be more fun than using a 100-year old instrument to key a brand new computerized all-the-whistles-and-bells transceiver? Lots of things, maybe, but this one ranks pretty high on my list.

—73 de Rich, WB9LPU

Appendix

An earlier attempt (the BugNapper I) to use magnetic slowing employed a pair of fixed magnets that operated on both sides of the pendulum magnet. This approach worked fairly well, but the parts count was high and adjustment was quite delicate. Its design also "used up" a fair amount of the length of the pendulum rod, limiting the adjusting range of the sliding weight.



The BugNapper I used fixed magnets, but was difficult to adjust.

A Trip to Mount Pinos

Mike Bavoso—W6YDE w6yde@arrl.org

On August 21, 2009 it was a hundred plus degree day in Fresno California. My wife was going to her mother's for the weekend. I was left home alone and was looking for something to do. I had heard about Mount Pinos from other amateur radio operators. I was told that it was a excellent location for mountain topping and to be prepared for wind. Being an avid "CW only" QRP operator. I decided to throw a few overnight supplies, generator to run an air compressor in case I got a flat, a QRP rig and a few antennas in my van and I was off.

Not knowing exactly where I was going, I headed south on highway 99 and then to interstate 405 to the town of Frazier Park. Frazier Park is located about a one hour drive north of Los Angles on top of the Grape Vine Pass. In the town of Frazier Park I found a mail lady filling mail boxes. I asked her about Mount Pinos and she told me to head towards the Lockwood Valley Road United States Forestry Ranger Station. After following her directions, I walked into the ranger station and was met by a U.S Forestry employee. I informed him of my intentions and showed him my ham license. He told me that we don't like ham radio operators; they seem to not follow the rules and get in trouble up here. I assured him that I was different and promised not to cause any problems. He stated "well you need to purchase a map". So I said okay, he said, "that will be $14". Well that was the ice breaker. He proceeded to point out and inform me of all the great spots that I could go and where I should not go, also not to climb or place any antennas on the fire lookouts. His co-worker gave me information about who to see in the town of Frazier Park to pick up some additional supplies. While at the ranger station I discovered that the generator's fuel tank cap was leaking onto the floor of my van. This meant no sleeping or overnight operating from the van.

Yeah, I'm ready for some QRP/portable mountaintop operating...

After picking up enough supplies and a light weight summer tent to spend the night I was headed to Mount Pinos from Frazier Park. This was about a forty-five minute drive. I located a camping site named McGill, with a overnight camping fee of $26.00, in the Los Padres Nation Forest located at 7,400 feet with clear views for hundreds of miles. I could even see the dry lake bed of Edwards Air Force Base, some 100 plus miles away. This was an excellent location with running water and bath rooms. I picked a camp site at the end of the road with a big flat spot on the edge of the mountain with a picnic table, fire pit and next to the bath rooms. I was all set and had gone to heaven. Nobody around, running water, my own bathroom and my wife was at her mother's for the weekend.

It was about 2:00 p.m. when I finally got parked and unloaded. The temperature in the late afternoon was around 65 to 70 degrees Fahrenheit. My first task was to set

Aha—The destination has been reached!

Camp is set up and (after some work) so is the station.

up the light summer tent. Next came the newly purchased YP-3 Yagi in a bag and a homemade tripod. I had purchased a number of these military surplus green fibreglass interlocking poles at the Visalia International DX Convention that April. The home made tripod was untested and proved to be my biggest down fall. The surplus poles were too large to fit through the tripod opening. With a few hours of hard work, I was up and on the air with a FT-817, a Begali paddle, the three element Yagi, a long wire, the smallest MFJ antenna tuner and a old car battery. I charged the battery the next day with three Harbor Freight solar panels.

I was on the east side of the mountain about 1,200 feet from the summit and the temperature and sun was falling fast. It was now around 45 to 50 degrees and it was time to start heating up something to eat. After dinner I got a little time on the air before I had to retreat to my tent to escape the mosquitoes. The van was still not usable due to the fuel smells from the leakage. Inside the tent I operated 40 meters on the long wire. 40 meters was alive with hundred of stations and contacts were effortless. The noise level on 40 meters was an absolute zero due to no man made interference.

The temperature was dropping and the wind was picking up so I decided to get into my light weight sleeping bag and get an early start tomorrow morning. Due to having only summer weather gear I froze all night. I thought that morning would never come with the wind getting stronger every hour of the night. The sun finally popped up over the distant horizon and it was 38 degrees on my thermometer. Have you ever tried getting up and fixing breakfast on an outside fire pit when you are prepared for summer weather ?

The day warmed up to a high of around 65 degrees. I got on 20 meters with my 3 element portable yagi and operated for about four to five hours. I was calling CQ when I came across a CW mobile station travelling between Idaho and Washington State. He could not believe that I was QRP portable. He gave me a signal report of 579. Others stations ranged from just about anywhere in the Pacific to Asia with Mexico to South America being no problem. Most of the reports I received were 569, 579 and of course the all famous 5NN.

I plan on returning to this same camp site but with a little more preparation for winter like temperatures. I found this to be an ideal location for a contest or field day operation. This was my first time operating out by myself and I will tell you that it is not like being at home. There are just so many things that we all take for granted and I learned that you cannot be too overly prepared. ●●

Here's the station set up on a picnic table.

A Confidence-Building Project for Newbie Builders

Pete Juliano—N6QW radioguy90@hotmail.com

About two years ago, I had a QSO on 20M SSB with a young man living in Alaska. I would judge him to be maybe 13 or 14 years old. We exchanged the usual reports and then he shared that he was running the following: IC-7800, Alpha 9500, and a choice of a StepIR or log periodic located on separate towers that were 100 ft high. On my comeback all I could say was "Wow", and then I asked "Was this a family station?" He replied he was the only ham in the family! On learning that his parents had bought him this super rig, I immediately felt sorry for him. I could never in a million years explain what he had missed. He never had a chance to build a single 6L6 oscillator on a wooden chassis, using popsicles sticks for a coil form and operating with but a single crystal in the 75M Novice band.

Obviously, many things have changed since the days when transmitters like the one described above were built by aspiring young hams. But, the thrill of building your own relatively simple equipment from scratch and operating a station you have built yourself is still a fantastic experience that you don't want to miss. So in case you also fall into the category of never having built your own gear, I propose to help you out of that deprived condition.

This article will describe a simple, single-band CW transceiver that can be built without the need for a super workshop filled with expensive test instrumentation and metal forming equipment. While not as simple as a one-tube transmitter, it is nevertheless easy to build with hand tools and a good temperature-controlled soldering iron. Circuits have been chosen for high reliability and ease of construction. Although this rig will not have all the bells and whistles of a commercial transceiver, it is NOT a toy. I have used my version to make many QSOs over thousands of miles.

Along the way, we will explore some "getting started" topics. There will also be some information constructing and testing the transceiver using simple tools, some of which you can build yourself. Finally, I will also suggest some additions you might want to make to your new transceiver once you have gained some confidence.

Designing the Project

For me, it seemed like the best place to start before building the actual radio is with an Objective Specification, which is actually multidimensional in the sense that there are three major components. The first of these involves the performance dimension meaning how well does the project perform and for this aspect there are some well-defined standards. Sensitivity, selectivity and linearity are perhaps the most well defined and known. These come with a price, meaning those with the very best of all these standards are in the tens of thousands of dollars and those with slightly less performance are in the thousands of dollars. The question here is what specifications can be achieved for around $100 which will still give reasonable performance? The second dimension involves what I call the "buildable" aspect, i.e., can this be built by someone with a basic knowledge of electronics using hand tools such as a soldering iron, electric drill and test equipment such as a DVM and a station receiver? The third dimension involves the use of standard through-hole parts and parts that typically cost less than $2 per single item. There may be some exceptions but for the most part that is an objective. Yes, I know that surface mount components have their advantages, but by intent this is a project aimed at those who have not quite reached that stage in home brewing.

So, here are our objectives:

- Easily replicated and can be successfully built by someone new to the hobby.
- Built with no special or exotic parts (available from common supply houses such as Mouser, Digi-Key, Jameco , Radio Shack, RF Parts etc.)
- Affordable with a cost target: No more than $100. No individual part to cost more than $2. (Goal)
- Aligned with test equipment such as a DVM and a station receiver and homebrew RF Probe and a small test oscillator.
- Built so that some of the circuits are used for initial alignment
- Built using known, well-understood, circuit building blocks. It is available, so use it. (Steal from everyone and anyone—I did!)
- Built using Manhattan style construction or single sided copper Vector Board.
- More than a "toy" and have features such as a XTAL filter for selectivity, a solid stable signal on transmit and a sensitive receiver. No DPDT knife switches for TR.
- Transmit with a power level of 1 watt (or more) to assure more than just a once in a lifetime contact.
- Used as a development test bed for improvements and adding features, e.g., manual gain control in the basic transceiver but the capability to add AGC as an option.

These objectives can be a tall order, but if attacked using a building block approach it can be done. The chosen approach also has the advantage of enabling experimentation and replacing individual blocks with improved circuits or new features. The cost limitation has some trade-offs such as no RIT, no AGC (but AGC capable) and no built in keyer. These features can be added later. That said, the $100 cost figure is not cast in stone. If it takes a few more dollars to include features that will distinguish this project from a toy that doesn't receive very well nor does it sound good on the air, then so be it.

Normally in a project of this type and especially when the builder is new to transceiver construction, I would at this point launch into a description of how the transceiver objectives were translated to a design and why several design choices were made. That will not be the case this time, as I would like the builder to be able to begin construction as soon as possible. So, we will leave that discussion for later. Here, suffice it to say that the design was based on (1) reliable circuits I had used before, (2) ease of construction, (3) a high probability of success in the hands of a novice builder, and (4) availability of low cost parts. Forty Meters was the chosen band for several reasons. First, 40M is open to somewhere almost 24 hours a day, so it is an excellent choice for a single

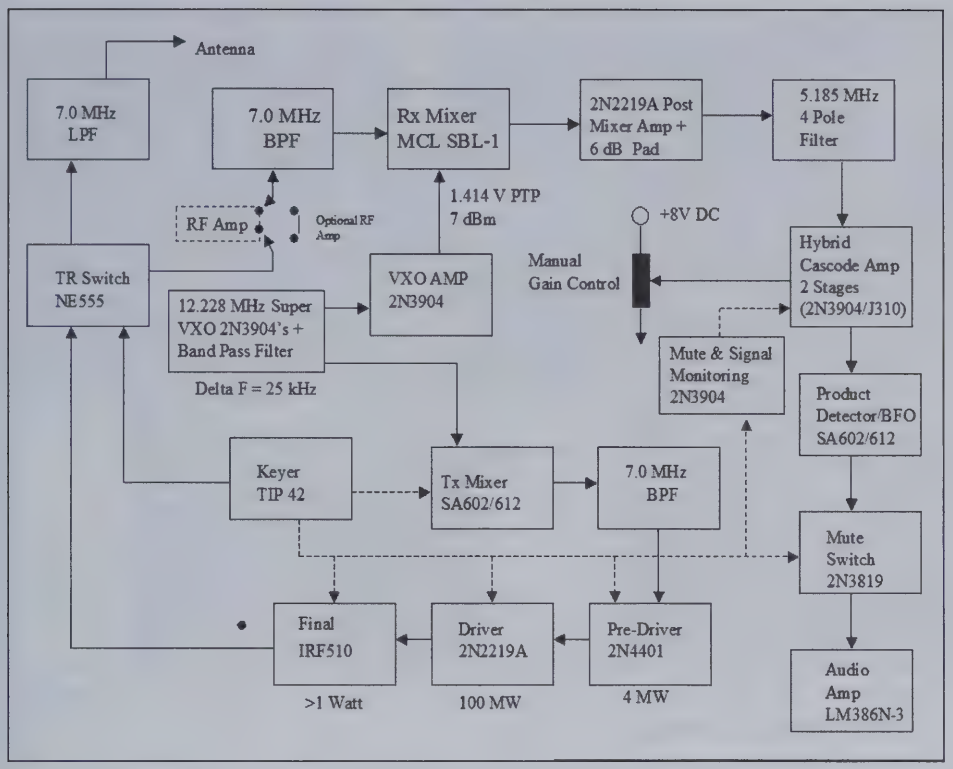


Figure 1—Transceiver block diagram.

band radio. Second, this particular band fortuitously allows the use of inexpensive computer-type crystals for the receiver filter and for the VXO (variable crystal oscillator). Computer crystals costing roughly 36 cents apiece at 5.185 MHz were selected for the IF stage and BFO. The VXO crystals at 12.228 MHz when down mixed with the 5.185 MHz IF frequency results in an output frequency around 7.040 MHz.

So for now, please refer to Figure 1 for a block diagram of the various stages used in the transceiver. As we progress through the construction, there will be schematic diagrams for each stage as you need it. Copies of the diagrams, which can easily be made larger if needed, are available on my website, http://www.jessystems.com. There will also be methods discussed for testing each stage, based on the use of some simple equipment that you either already have or can readily construct at low cost.

If you find yourself unfamiliar with the function of a particular stage in the transceiver and can't proceed without at least a bit of explanation, I suggest consulting one of two excellent references, both available from ARRL that have long formed a part of my library. The first reference is *Experimental Methods in RF Design*, commonly known as EMRFD. EMRFD was authored by the "experts": Wes Hayward, W7ZOI, Rick Campbell, KK7B, and Bob Larkin, W7PUA. This publication is the "bible" for hams involved in construction and if one were to acquire a singular source for reference material, this would be it. Several of the circuits used in this project are a direct lift from EMRFD. You may also want to join the EMRFD reflector currently housed on Yahoo Groups. The second is the *ARRL Handbook for Radio Communications*. Any recent edition is sufficient, as you will only need some quick parts specifications and basic functional explanations of stages and/or components for our purposes. You may even find a copy of the *Handbook* in your local library and save yourself some expense.

Buying the Parts

Now we only need to consider one more thing before we begin building the transceiver—how do you know which parts you need and where will you find them? The basic answer is easy. I have placed an itemized parts list, showing suppliers and part numbers, on my website. Parts are shown by total quantity needed and by stage. Suppliers were chosen to minimize the number of suppliers used. However, if you have some parts already then you might want to review the list and see if you can reduce the number of suppliers further as this may reduce shipping costs. Also, for many parts, you will find that there is a price break at certain quantities. If those parts are not expensive, then you might want to think about ordering a larger quantity just to have some extra stock on hand.

As an option to buying just the parts needed for this project, you might also consider buying a larger set of parts that would serve as a "junk box" for future projects. As you build this project and read about other projects in this publication, you will observe that many of the parts appear over and over. So, buying a significant quantity of these common parts will probably save money in the long run. If you are interested in this approach, see the companion article in this issue titled "How to Stuff a Junk Box".

Now let's get started building something!

Some Necessary Test Equipment

One of the project objectives was that the radio should be buildable using simple test equipment. In this case, the equipment needed is an RF probe and a crystal oscillator. If you don't already have these two pieces of equipment available, we will build some simple versions that are quite adequate for this project.

Let's build the probe first. What does a RF probe do? Essentially, the RF probe detects RF voltage and converts it to a DC voltage, which can then be measured with a common digital voltmeter (DVM). We will use the probe to verify various circuits are working and as a part of the alignment process. This probe will also help the newcomer to read schematics and get some actual building experience. There is no need to be fancy here—it just needs to work.

Appendix I shows the schematic and my version of the probe. The probe enclosure was built using single sided copper PCB board. You will need a plastic miter box and some 32-tooth hacksaw blades, both of which can be purchased at the local hardware store for a total cost of about $7. Using the miter box one can make very straight cuts and the result is what you see

in the picture. I use some wood blocks and large rubber bands to hold the PCB pieces in place while I solder them together. You don't need to "weld" the box together; just several solder tacks on each side makes the box rigid. I drilled the end plates first, before I soldered them in place. The sketch in Appendix I is dimensioned and is just about the right size to cut with hand tools. All Electronics (they have a website) sells 4" x 6" single side copper PCB board for around $2.50 per sheet, if you can't find some at a local hamfest. To build the probe box requires a piece 2" x 4", so lots left over from a single sheet. One caution when sawing the PC board: Wear a dust mask and vacuum up the debris. If you don't want to use PC board, you could use tin plate instead. Local hardware stores or a good hobby shop should have this material. This is ideal for making small boxes as the metal is easily bent in a vise and the bonus is that it can be soldered.

Next build the crystal oscillator, also shown in Appendix I, as this will essentially become a signal generator to align portions of the receiver. When you are building the oscillator, bear in mind that you will probably be changing crystals used in the oscillator quite often. So, it will make sense to construct the oscillator so that crystal change is easy. The beauty of the crystal oscillator, when built using a 5.185 MHz crystal, is that the output can be used to align all of the receiver circuits from the post mixer amplifier through to the audio amplifier. [Important note: Crystals used in the test oscillator must have a 32 pF parallel load capacitance.

The parts list on my website lists these crystals separately.] If the constructor acquires a 7.030 MHz fundamental crystal (available from Kanga US for $5 each or 3 for $10 plus shipping) and installs that in the oscillator then it will also become a signal source to test the completed receiver. The 7.030 MHz signal also gives the constructor a reference source to know where the receiver (and transmitter) is tuned. And, if you hook up a key between the oscillator and its power supply, you have a wireless code practice oscillator. Once the oscillator is built, the RF probe can be used to test the oscillator to assure that it is working. These two pieces of test equipment will prove most handy and can be used for other projects that may be undertaken in the future.

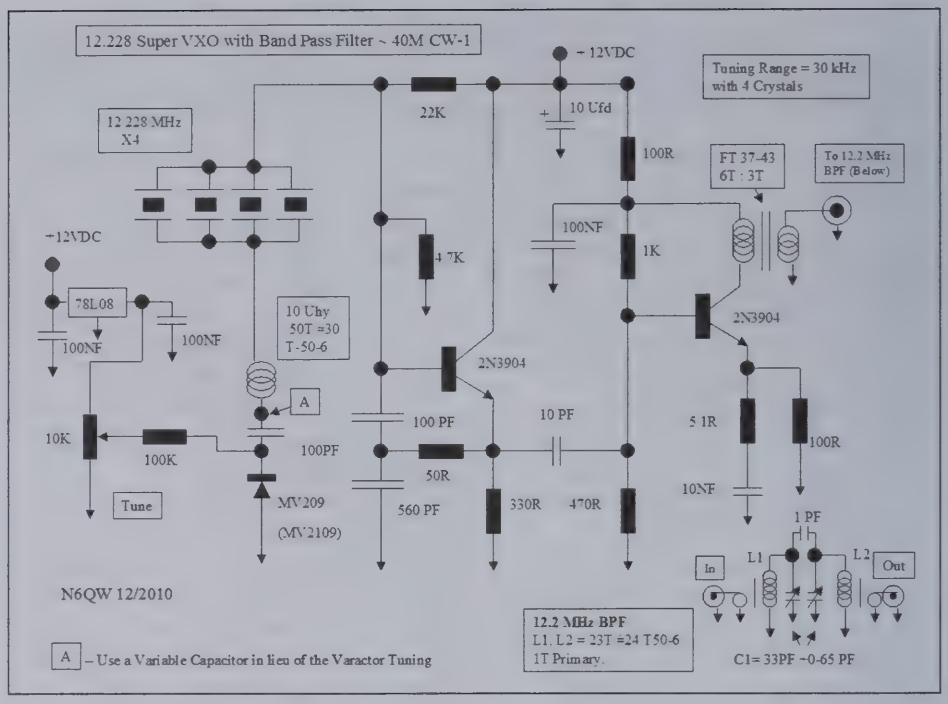


Figure 2—VXO schematic.

Finally the Project

The project has been purposefully built on three separate boards. One board contains the receiver, the second the variable crystal oscillator (VXO) and the third is the transmitter board. Building the receiver and VXO first will enable using that part of the project to test and align the transmitter. We'll start with the VXO as it is the section having the fewest components needed to provide a complete function in our transceiver. This will also provide some experience to tackle the more detailed circuits found in the other parts of our project.

Figure 2 is the schematic of the VXO and the 12.2 MHz Band Pass Filter. There are several methods to build the VXO—builder's choice here.

The method I used for the VXO is to grid a 2 x 3 in. unetched PC board and to create islands on the copper board while leaving a copper border similar to a picture frame around the perimeter of the board. I happen to have a mini-milling machine and so this was easy for me to do. An alternative to this is to purchase one of the hobby type tools similar to a Dremel and, using an abrasive wheel, cut the squares by hand. A big caution: Use a dust mask as inhaling the dust is dangerous to your health.

A second method is to use single sided copper vector board. A sheet 4.5 inches by 17 inches costs about $20 and certainly exceeds our $2 a part construct but there is plenty left over for other projects—so think of it as part of the junk box stash. The receiver and transmitter boards were built using this material. Each board is 3 in. by 4.5 in. The single sided copper vector board is somewhat expensive but makes for rapid prototyping as all connections other than ground are made on the underside of the board which is not grounded. When passing components through the holes I enlarge the area on the copper side of the board using one or two twists of a drill bit so that there is no possibility of the component touching the ground plane. For components that go to ground, they are simply passed through the hole and soldered to the ground plane. For small capacitors this may be hard to do, so I simply pass the lead through the board and loop the lead wire back through the underside of the board through a second hole and solder it in place on the ground plane side. If you do use a vector board, you will find that transistors and integrated circuits will be easier to mount on the vector board if sockets are used for these components. Accordingly, I have listed the sockets you need in the parts list. If you don't use vector board, then the sockets are optional.

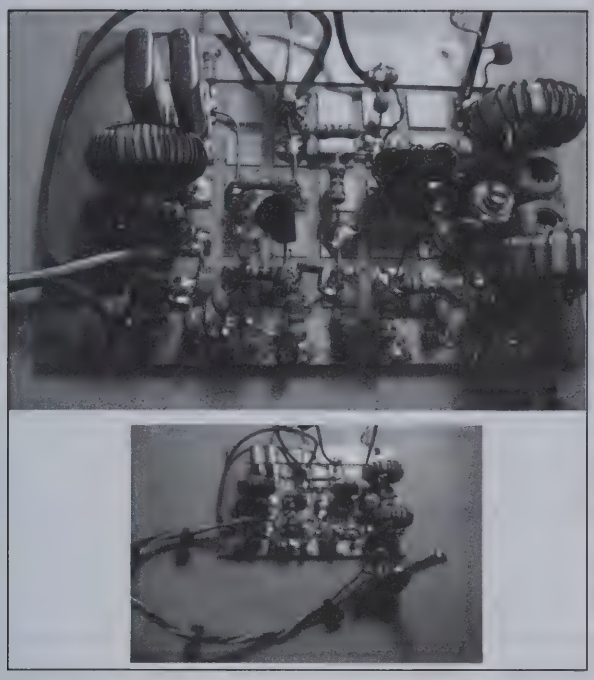


Figure 3—VXO layout.

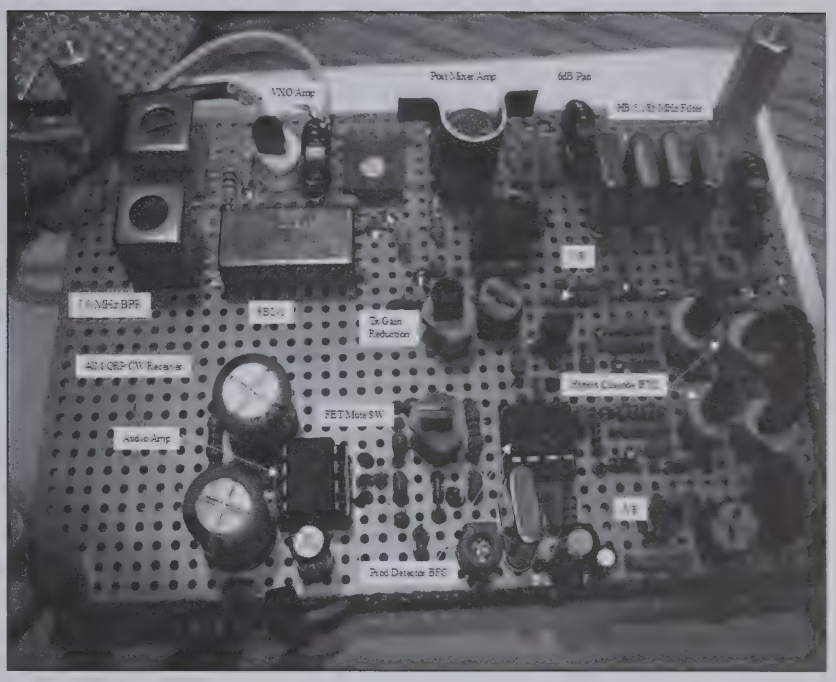


Figure 4—The finished receiver layout.

A third method is to use a 2 x 3 inch piece of single sided copper board as a ground plane and to take thin 1/4 to 1/2 inch wide strips of the same copper material and cut them into small squares. These small squares are super-glued to the copper board in a manner that generally follows the circuit schematic. This method, known as the Manhattan style of construction, provides isolated pads to interconnect wires while providing a common ground plane. A little study of the circuit diagram will reveal a pattern of how to layout the blocks. However, if you are new to construction it might be better to start with one of the earlier methods above for this project. Then, begin your use of the Manhattan method with a smaller project.

Start by collecting all of the components for the VXO so that you are assured that you have everything needed. Herding the parts is always problematic, as it seems they always want to go astray. One handy method to herd parts is to acquire one of those Styrofoam egg cartons and separate the top from the bottom. Suddenly you have twenty-four small bins to collect parts and recycled something to boot. Figure 3 is a photo of my VXO and that should give you some idea of how to arrange the parts. Since all connections are made on the top of the board, in the final assembly the boards for the milled squares or Manhattan approach are simply mounted right to the chassis or box. This provides an excellent ground connection. If you use copper vector board, the board must be mounted on threaded pillars since there are interconnects on the underside of the board.

The VXO may be tuned through its range in several ways. One is to use an actual variable capacitor. If you have one in the junk box by all means use it. Something in the range of 50 to 100 pF would be suitable. If you don't have a variable capacitor on hand, Antique Electronic Supply (www.tubesandmore.com) sells the model CV198 for an unbelievable price of $3.95. The 85 pF section alone should be sufficient. If not, add the 25 pF section in parallel. If you are tempted to use the type of capacitor commonly called Polyvaricons, DON'T. Wes, W7ZOI, in a December 2010 post on the EMRFD reflector, made some measurements on these devices and his test results indicated that they were not well suited for this application. Since variable capacitors are becoming a dying breed, I opted to use varactor tuning controlled by a DC voltage. The varactor diode works very well and is mounted right on the same board as the VXO. Tuning is done with a 10k ohm potentiometer and makes for a smaller footprint. If you do decide to use a variable capacitor, Figure 2 shows the location where it may be substituted.

Building the VXO itself is straightforward and should not present any problems. The one thing which may be new to you is winding toroidal cores to form inductors and transformers. It's easy. Just remember that each time a wire passes through a core counts as one turn on the inductor. The coils in Figure 2 (and elsewhere in this article) are described nearby. For instance, "10 uH 50T #30 T50-6" means, "This is a 10 uH inductor composed of 50 turns of #30 wire on a T50-6 core." Where a transformer is specified, the coil with the most wires is wound first. Then the other side of the transformer is wound over it in the same direction.

The first rule of thumb after you complete the wiring is to not power the unit until you have taken a coffee break of at least 10 minutes. Then, check all of the wiring to assure there are no cold solder joints and no wrong connections. That 10-minute rule has been a lifesaver for me. As a suggestion, build just the VXO and the buffer amplifier stage first and get that part working; then add the Band Pass Filter.

Ok, so how do I know that the VXO is working? Well if you have access to a general coverage receiver you can hear the signal on a radio which tunes 12.2 MHz. No signal means then you have something wrong such as a cold solder joint or a bad connection, or a bad part. Start the trouble shooting process by looking at voltage levels on the collector and emitters of the

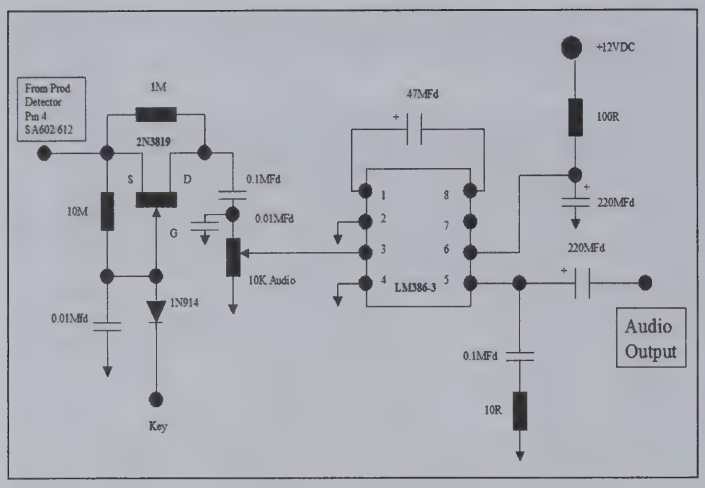


Figure 5—Audio and mute switch schematic.

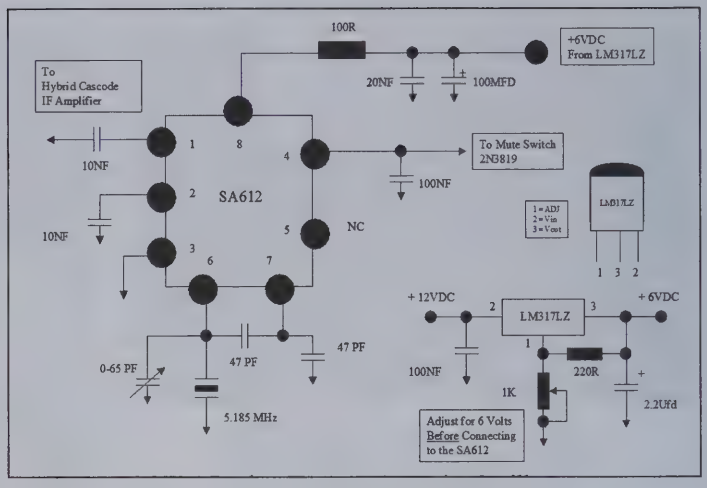


Figure 6—Product detector schematic.

2N3904s. Collectors should show nearly +12 V and emitters should show a voltage substantially above zero. If you have access to an oscilloscope that is even better as that will enable you to visually look at the output measured at the output of the 6T:3T transformer in Figure 2. Using the RF Probe to check for signal output would be a third method. Each of these methods give an indication that the circuit is working. Used in combination, that will give a better picture of the functioning of the circuit. Using the external receiver will not only tell the presence of the signal but the tuning range of the VXO.

Now we have one more step before going on to the next part of our project. We have to build the low pass filter at the bottom right of Figure 2. The variable trim capacitors each consist of a 33 pF fixed capacitor in parallel with a 0 to 65 pF variable capacitor. Once you have finished the filter, check out the VXO as you did in the paragraph above to make sure your filter is working. Once you are satisfied it is working, place the RF probe at the output of the filter and adjust the variable capacitors in the filter so that signal output through the filter is maximized. With the filter peaked, signal levels should be about the same as before the filter was inserted.

Once completed and functioning -pat yourself on the back for a job well done! Take time to reflect on what you have learned in this part of the project, as that will be most useful as you tackle the next phase which is the receiver.

How shall we start building the rest of the receiver? Some advocate starting backwards, building the audio amplifier first and then temporarily powering up the receiver and testing the circuit. I subscribe to that approach because "build and test as you go" saves a lot of grief! But before we begin, let's find out what the receiver might look like when it is finished. My version is shown here in Figure 4. Study it a bit so that you can get an idea of your overall layout of the stages.

Now, let's start with the output audio amplifier. The receiver is designed for use with headphones and you will need them right away to test the audio amplifier. Make sure they are the 8 ohm variety. Some of the popular replacement type "Walkman" headphones are a much higher impedance and that significantly reduces the volume available.

The schematic for the Audio Amplifier and Mute FET Switch is shown in Figure 5. Once the audio amplifier is built, there is a simple test. Plug in the headphones and power up the circuit. Using a small screwdriver blade, touch the center pin on the Volume control. It should emit an increase in background noise. When wiring the volume control, check to make sure that as you advance the gain control clockwise there is an increase in volume. You can test this by placing the screwdriver blade on the ungrounded end of the control and see if as you rotate the control clockwise the volume increases. If it is the reverse, you have the option of switching the wires on the control or on the board.

My usual wiring approach for volume controls is to take three different color wires approximately 10 inches long and start by twisting two of the wires together. Once that is done twist the third wire in the same direction as the two previously twisted wires. This will form a neat three-wire cable. Using two small plastic cable ties I secure each end of the cable approximately 1.25 inches from either end, as this prevents the cable from unwinding. At least one of my three wire cables is green and that is so I remember that green is ground. The twisting of the wires provides some noise isolation and extraneous pick-up.

Next wire up the mute switch. You can test the switch by touching a small screwdriver blade to the mute switch input while grounding the point marked "key" on Figure 5 with a test lead or other temporary connection. (Be sure you ground all metal before touching the circuit as FETs have a tendency to fail when subjected to static electricity.) There should be very little background noise until you ground the key input node. Leave the key input node grounded while building the receiver so that you won't have to remember to ground it each time.

Just prior to the mute switch and following the IF amp stages is the Product Detector, which converts IF signals into the audio range. See Figure 6 for the schematic. Note that it uses the marvelous SA602/612 (either variant works well) which performs this function with just a few capacitors, a crystal and of course the IC. The SA602/612 is a lower voltage device and works nicely from 5 volts to 8 volts. I chose to use 6 volts and this can be supplied by a local voltage regulator. The LM7806 voltage regulator is one convenient way to provide the six volts, or you can do as I did and use a LM317LZ. The LM317LZ enables the builder to create a

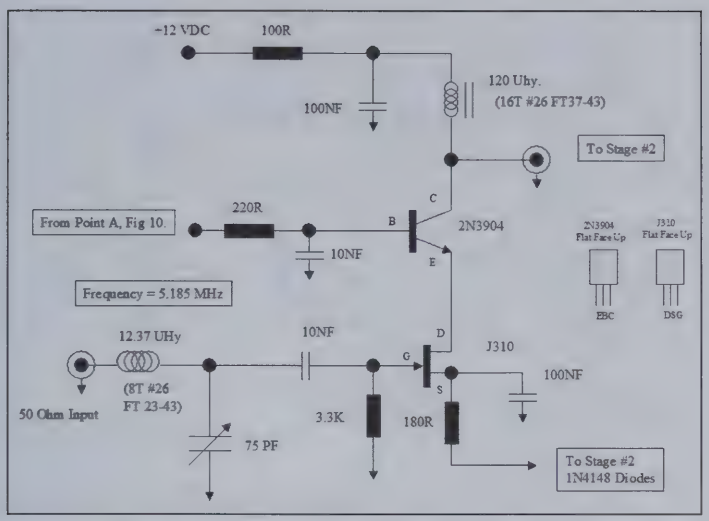


Figure 7—1st stage IF amplifier.

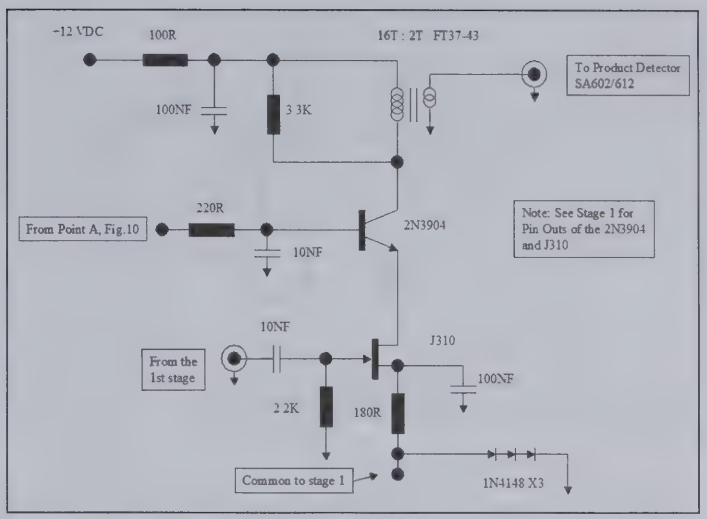


Figure 8—2nd stage IF amplifier.

regulated voltage supply across a wide range of voltage levels with just a few external components. So, the LM317 is almost like pantyhose—one size fits all. There is nothing worse than to be working on a project and suddenly find the junk box does not have a special regulator. The only caution is that the source voltage must be 2 volts or so above the voltage being regulated. If 12 volts were being used to power the receiver, then the max variable output would be about 10 volts. (The datasheet for the LM317LZ has the formulas to calculate the resistance required for various ranges of voltages up to a maximum of about 35 VDC.)

The one slightly tricky part about building the product detector concerns the crystal used with the SA612. This crystal, like the one used in the test oscillator, needs to be one of the crystals specified with a 32 pF load capacitance. This is different from the batch of ten crystals soon to be used in building the crystal filter so be sure you use the right part number. Once the radio is complete some swapping of crystals might be necessary to find one of the crystals that place the BFO signal in proper relationship to the crystal filter pass band (which is why we bought extra crystals). You may get lucky but most of the time this ends up being a little cut and try. So, solder the crystal into the circuit with the idea that it may have to be replaced once the receiver is complete.

Once the product detector has been built and the usual check for cold solder joints and wiring errors made, it can be powered up and the following tests made. After power on, start first by placing the RF probe on Pin 6 of the SA602/612 and insure that the BFO is working. To assure oscillation, an adjustment of the trimmer cap attached to pin 6 maybe required. Once you are sure it is oscillating, there should be a perceptible noise coming from the headphones. Now take the crystal test oscillator and, with a short piece of wire for an antenna, bring it in close proximity to pin 1 on the SA602/612. You will hear the output out of the speaker since the Product Detector is essentially doing its job. If you do not hear the signal from the oscillator, check to see if 6 VDC is being supplied to the SA602/612 and then look for obvious wiring errors. In a rare case you might have to solder in a different 32 pF load crystal into the test oscillator to give enough of an offset so that a signal is detected.

Our next stop is the two Hybrid Cascode IF amplifier stages that are essentially daisy chained. There are some differences as the first amp has its input matched to the output of the homebrew crystal filter and this is shown in Figure 7. The second stage has its output matched to the input of the Product detector, as shown in Figure 8. The control point marked on both figures as "To Point A, Fig. 10" leads to a voltage which controls the gain of both IF stages. More about that when we discuss Figure 10. Figure 9 is a photograph of the Hybrid Cascode IF amplifier stages. Look carefully at the layout, as I spent some time trying to figure out an optimum layout to minimize the wiring and parts placement. This is a high gain stage and what we want is just the signal amplified and not everything else.

Keep in mind this project is a transmitter-receiver, so it is possible to listen to the outgoing signal. We use this attribute to actually set up the offset for the transmitter and to also provide a convenient means of hearing what you send. BUT, having the receiver on while transmitting can be ear splitting and thus we have added a simple transistor switch which lowers the IF gain during transmit. Figure 10 shows this circuit. If we simply connected the collector of the DC switch (the venerable 2N3904 controlled by the TR switch) directly to the junction of the two diodes, it would cause 0V at Point A during transmit and essentially cut-off the Hybrid Cascode IF stages. By placing a small 1k potentiometer in between the 2N3904 collector and the junction of the diodes, the bias voltage at the input to the 220? resistors in the IF amplifiers can be lowered to a convenient value during transmit and IF gain is reduced but not cut off.

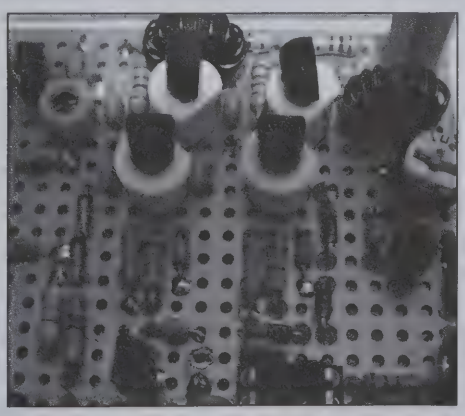


Figure 9—IF section layout.

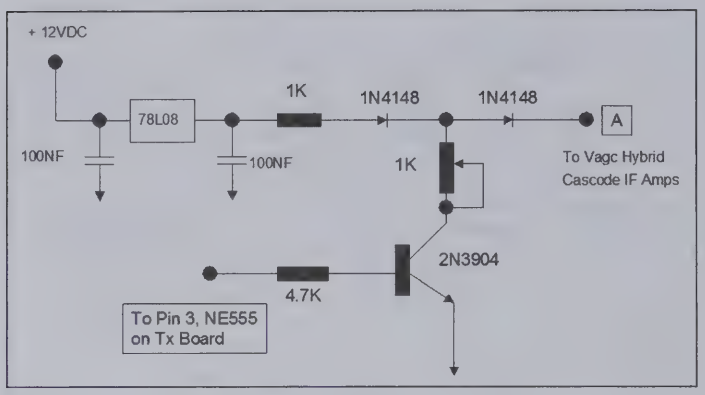


Figure 10—Transmit gain reduction schematic.

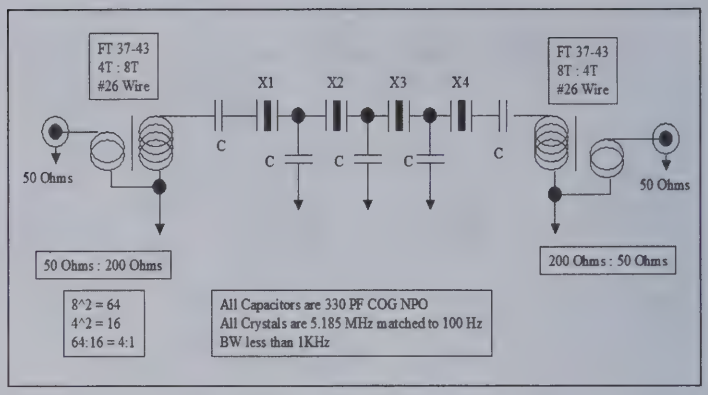


Figure 11—Crystal filter schematic.

I hate to sound like a broken record but when the wiring for this section is complete, take the ten minute coffee break and come back and look for cold solder joints and incorrect wiring. When you are satisfied all is well, power up the product detector, mute switch and audio amp and make sure these are still working using the test stated earlier. This is done so that once you apply power to the Hybrid Cascode IF stages any problems will be in those IF stages and not elsewhere. Ok, so apply power and run my simple test—physically touch the input of each stage, the second stage first and then the first stage. If it is working properly you will hear a loud signal in the headphones. If you don't hear any large increase in background noise, check the following: 1) Is the diode in the audio mute switch shorted to ground? 2) Has power been connected to the stages and is +8 VDC present at the point marked "To Point A, Fig. 10"? 3) Did you put the active devices in the right place and not reverse the 2N3904 with the J310? Check for any components being shorted to the ground plane? By using the approach I specified, you will only need to isolate the problem in the IF stage that is not working.

Now for the scientific way of testing the IF amp stage. Connect the test oscillator to power and bring the output in proximity to the L network on the input side of the first Hybrid Cascode IF stage. The signal should be readily detected.

Once you have satisfied yourself that the IF stages and all subsequent stages are working, it's time to begin work on the crystal filter which will provide signal selectivity to our receiver. The construction of homebrew ladder crystal filters is well covered. AADE (Almost All Digital Electronics) has a design tool available on the Internet and it takes a lot of the drudgery and mystery out building one. EMRFD likewise covers building crystal filters in a great amount of detail. I didn't use either as I have built quite a few filters without going through the rigorous calculation process. For the purist, follow the guidelines in EMRFD. How I do it should get one close enough. The type of filter we are building is known as a Cohn filter and tends to favor lower sideband. The schematic for the Home Brew Crystal Filter is shown in Figure 11. Because of the frequency scheme we will be employing where the Local Oscillator (LO) in this case is above the IF frequency, we require a subtractive process for producing the IF signal. This causes the sidebands to become inverted. This process is shown here: 12.215 MHz (LO)—the desired frequency (7.030 MHz) = 5.185 MHz (IF). The process causes the received signal to end up on the USB side, which is propitious as we will see later on when the transmit mixer is built.

The Cohn-type narrow ladder filters used here tend to be easier to build, one reason for the design choice. The key to shaping the bandwidth of the filter is the value of the coupling capacitors, all of which are the same value. A rule of thumb is that the smaller the value of the coupling capacitor, the wider the filter. Many CW type filters typically use 470 pF and most of the SSB type use something less than 100 pF. For my ears, 470 pF is a bit too narrow and so I opted for 330 pF and that seems OK for me. I am judging that the bandwidth is on the order of about 1 kHz. For the purists and those with access to an accurate signal generator and oscilloscope it is possible to actually plot the response curve. The trick here is to insure that the filter is properly terminated at its design value of approximately 200 ohms while making the measurements.

The first step in building the filter is to find four crystals whose oscillation frequency is within 50 to 100 Hz of each other. To assist in finding a good group of four, we need to buy about ten crystals of the series type with the same nominal frequency of 5.185 MHZ. With ten identical crystals purchased at the same time, at least four of the ten will probably be within 50 Hz to 100 Hz of each other. So now the problem becomes one of how to measure the frequency of the ten crystals. If you have access to a frequency counter, using it to measure the precise frequency of the signal produced when placing each crystal in your test oscillator is the most direct method. Take a felt tip pen and number the crystals from 1 through 10. Then using the oscillator and frequency counter, measure each crystal and note the frequency on a piece of paper such as "#1 = *xxxx* Frequency". Then by inspection, note the spread among the frequencies and attempt to find the four closest ones in frequency.

If you don't have access to a frequency counter, you can tune a general coverage receiver to the crystal frequency and listen (with BFO on) to the output of the test oscillator. As you change crystals, listen to the signal and find the four crystals that produce a tone closest to each other. This should work because the human ear is actually quite capable of discerning small differences in the pitch. If your available receiver covers only the ham bands, then you may want to jump ahead a bit and construct the double balanced mixer in the receiver (see Figure 12). Feed the test oscillator output through a 10 nF capacitor to the mixer at the point labeled "RF input

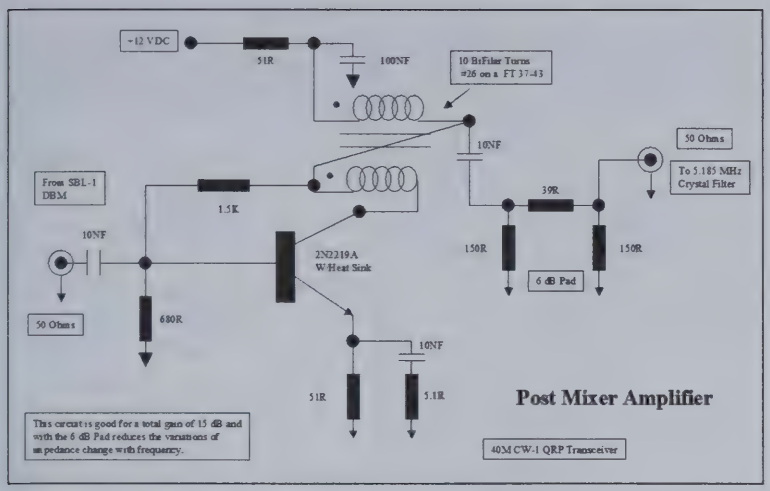


Figure 12—Post-mixer amplifier schematic.

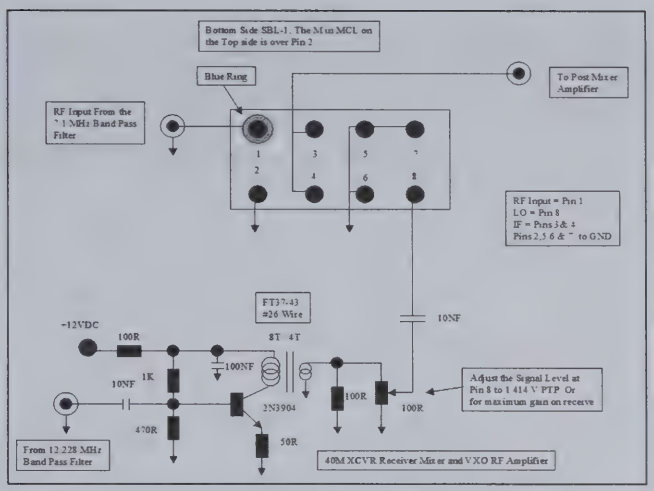

Bottom Side SBL-1. The Mini-MCL on the Top side is over Pin 2
Blue Ring
To Post Mixer Amplifier
RF Input From the 7.1 MHz Band Pass Filter
RF Input = Pin 1
LO = Pin 8
IF = Pins 3 & 4
Pins 2,5 6 & 7 to GND
FT37-43 #26 Wire
8T 4T
10NF
+12VDC
100R
100NF
10NF
1K
2N3904
100R
100R
470R
50R
Adjust the Signal Level at Pin 8 to 1.414 V PTP Or for maximum gain on receive
From 12.228 MHz Band Pass Filter
40M XCVR Receiver Mixer and VXO RF Amplifier

Figure 13—Mixer and VXO amplifier schematic.

from the 7.1 MHz bandpass filter" and the VXO output to the mixer at the point noted in Figure 12. This should result in one output within the 40M ham band near 7040 - 7030 kHz that you can hear in your receiver. (Note: There will also be other outputs since we haven't done any filtering of the mixer output yet. But, these other outputs will be filtered out by the receiver.) Then alternate the ten crystals through the test oscillator and select the four that are closest in frequency to each other. The exact frequency is not as important as having the chosen crystals be close to each other in frequency.

Begin the building of the crystal filter, by winding the matching transformers and installing the crystals and coupling capacitors. (See Figure 11). The purpose of these transformers is to match the crystal filter input/output impedance, which is typically 150 to 200 ohms for four pole filters of this type, to the 50 ohm impedance of the prior and following stages. Assuming a 200-ohm in/out filter impedance, a 4:1 match is required. Small FT37-43 ferrite cores were used to make the transformer cores and the matching is based on the turns ratio squared. So if we wind eight turns as a secondary and four turns as a primary, we should get our required 4:1 match. The four turn side would be 50 ohms and the eight turn side would be 200 ohms. In each case, the eight turn side is connected to the filter in/out and the four turn side is the 50-ohm interface to the other circuits.

The matching transformers are built in the manner described earlier. The bottom ends of both windings are connected together and soldered to ground. Once the filter is built, connect the output side to the portions of the receiver you have already built. Power up the Test Oscillator and bring the signal lead near the end of the filter that would connect to the Post Mixer Amplifier. Have the receiver turned on and the signal should be heard in the headphones. You may have to adjust the trimmer capacitor at pin 6 on the product detector. The BFO frequency is properly set with the trimmer adjustment so that when you tune across the signal the CW tone will become clear and easy to distinguish. Trust your ears. And, be careful as the output will be loud!

Ahead of the filter and following the mixer is a post mixer amplifier. I used a well-known, W7ZOI post mixer amplifier design to add about 20 dB of gain. The post mixer amplifier is followed by a 6 dB pad, so the effective gain is only in the range of 15 dB. Why the pad? The design of the amplifier is such that the mixer "sees" an impedance which partly results from the crystal filter. Frequency dependent impedances are generally bad news to a mixer. So, the pad reduces the effects of this frequency dependent load. Figure 12 shows the detail of the Post Mixer Amplifier and pad. Pay particular attention to the two dots on the transformer in Figure 12. These are phasing dots, showing how the transformer is to be connected to the rest of the circuit. If you are unfamiliar with how phasing dots work, you can find an explanation in any *ARRL Handbook*. Once this stage is built, connect it to the rest of the receiver, power up the Test Oscillator and bring the test lead near the input to this stage. Once again, proper circuit operation is indicated by a large signal being heard in the speaker.

The next stage is the Double Balanced Mixer (DBM) and VXO amplifier shown in Figure 13. The DBM was chosen for several reasons, one of which is the large signal handling capabilities. That said, the SBL-1 is a loss device (about 6-10 dB) and that is the main reason why we built the Post Mixer Amplifier. The DBM is an SBL-1, a packaged unit available from Mini-Circuits Labs. Other packaged units from MCL will work, such as the TUF-1 (smaller size), the ADE-1L (SMD version) and the SRA-1. The SBL-1 is a 7dBm device, which means that it requires 1.414 V peak-to-peak of VXO signal to drive the DBM. To insure that there is sufficient signal being supplied to the DBM, I included a booster amp ahead of the VXO signal. This amp provides a variable output to assure that there is sufficient LO drive.

To test the DBM circuitry, temporarily tack solder a length of wire to Pin 1 on the SBL-1, Connect the VXO board output to the input port of the of the 2N3904 VXO amplifier. I suggest using a short piece of RG-174U coaxial cable with the shield grounded at both ends for the connection. With this arrangement, you might actually be able to pick up some stations but what we really want to listen for is a signal from our test oscillator with the 7.030 MHz crystal installed. In my version of the test oscillator, I bought some sub-miniature DPST slide switches and thus am able to switch between the 5.185 MHz crystal and the 7.030 MHz crystal. You may want to do the same. When you turn on the test oscillator, tune the VXO and you should be

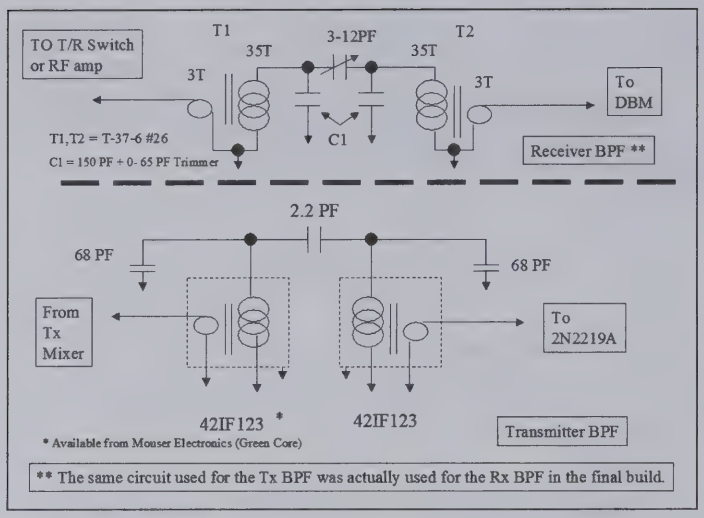


Figure 14—Receiver bandpass filter.

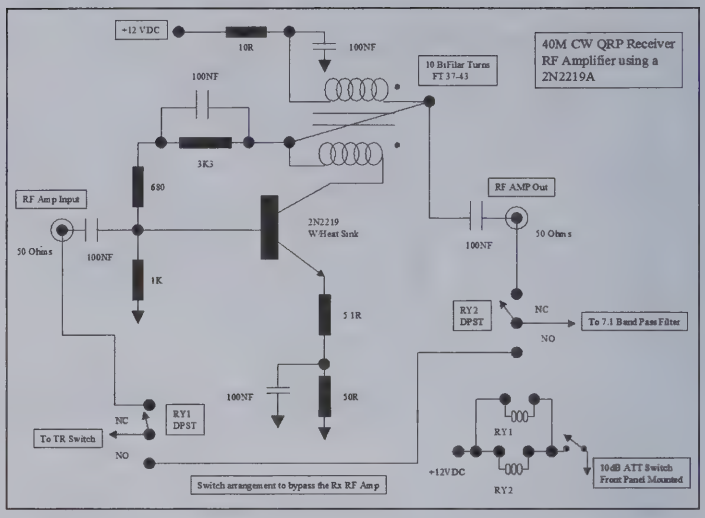


Figure 15—Receiver RF amplifier.

able to pick up the signal on the receiver. You might have to adjust the small trimpot (100 ohms) on the DBM board to insure there is sufficient LO signal to drive the SBL-1. If you do not hear the signal, check your wiring and look for any shorts or cold solder joints. Do Not connect the test oscillator to an outdoor antenna. There is actually enough signal power present to be heard at unexpected distances.

When all is checked out, proceed to installing the 7.1 MHz Receiver Band Pass Filter shown in Figure 14. There are actually two such filters in the transceiver, one for the receiver input and the second for the transmitter board. Both filters are identical. For now, you need only build the receiver filter. If one chooses the copper vector board or squares building option, the IF transformer cans can be soldered directly to the boards. Note one set of windings terminates in three small pins for connections. The two outer pins align with the holes on the vector board. The center pin does not and is not used for any connections but would align with an area between two adjacent holes. I simply take a sharp Exacto type hobby knife and cut between the two adjacent holes and carefully remove any copper around the enlarged hole. The center pin slips in there nicely and there are no problems as the other holes align. The holes may need to be slightly enlarged to accommodate the pins. Do Not remove copper from around the holes for the outer pins as the tabs will be soldered to the vector board.

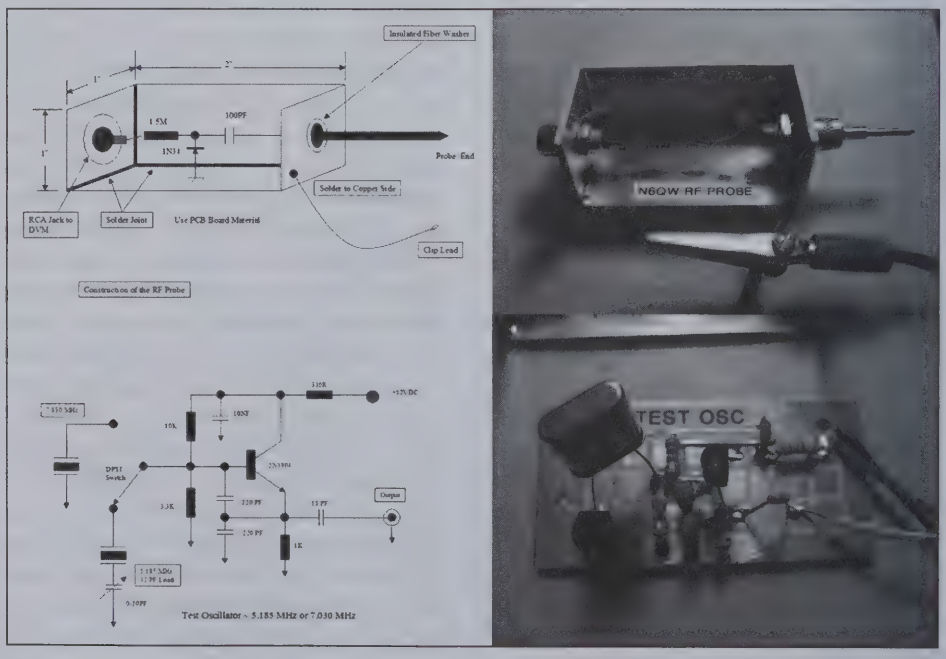
Once this part of the circuit is complete, connect a short wire to the input part of the circuit and power up the test oscillator with the 7.030 MHz crystal in place. Tune the VXO for the signal and peak the two cores and tune for maximum signal. Or as we used to say in the old days of tube transmitters, "Tune For Maximum Smoke".

This completes the basic receiver, my version of which was shown earlier in Figure 4. You can now run some tests by hooking up your favorite outdoor antenna. Depending on the time of day such as early morning or early evening, you should hear plenty of signals. Mid-day on 40M tends to be a bit quiet. Bask in the glory for a moment at having built, tested and made functional your very own receiver.

In the next installment, we will construct the companion transmitter board and add an RF receiving amplifier which may be helpful in receiving weaker signals. In the meantime, you may want to build a temporary RF receiving amplifier on a piece of scrap PC board as shown in Figure 15. If you do build the amplifier, then be sure to try your receiver with and without it. You may find that the amplifier is not needed at your location. If so, omitting the amplifier will improve the receiver's strong signal handling performance.

Good luck with your new receiver and join us next time for the completion of this project. If you run into any trouble, e-mail me and I will try to help.

—73, Pete, N6QW



Appendix—Construction recommendations.

Making A Software Defined Radio for the QRP Enthusiast: Part IV

Ward Harriman—AE6TY ae6ty@arrl.net

Those of you who have been following this series of articles know that the description of the "SDR" portion of my project is now complete. At the conclusion of Part III of the series, a fully functioning SDR receiver and transmitter had been described. However, the output amplitude of the transmitted signal was too small even for most QRP users. So, a transmitting amplifier matched to the SDR was in order and will be described here.

I am an active home brew enthusiast and as such, I've read through a large number of articles and built many circuits described by other designers. Many times I've asked myself, "But how did he get here?" Seldom does anyone bother to describe the actual design process. In this paper I hope to show not just the result of the design process but also 'HOW' I got to the endpoint. My goal is not to provide a complete circuit you can just build, but to show you the tools necessary to design your own.

This paper chronicles the design of a Class E, 20 meter, QRP transmitter. This was my very first power amplifier and I got started with a great deal of trepidation. During the design process I found that the class E amplifier is very simple to understand and design and extremely easy to make work correctly. I hope you will find the following enlightening and empowering. There is nothing quite like designing, building and operating your own brainchild.

In the design process, I use four free tools from the internet: "ClassE" from Tonne Software, LTSpice from Linear Technology, Elsie from the ARRL software toolkit and "SuperSmith" from Tonne Software. I highly recommend these tools to anyone actively designing circuits in the HF bands.

The Power Stage

Class E amplifiers are closely related to class C amplifiers. As such, they are generally non-linear and can be used best for CW and FM operations. As with class C amplifiers, class E amplifiers use a transistor as a switching element which is either completely 'on' or completely 'off'. The major advantage of the class E is the higher efficiencies achievable with proper tweaking.

The design of a class E amplifier starts out with a free tool from Tonne Software called "ClassE". This software can be downloaded from www.tonnesoftware. com. This software is extremely easy to use. Figure 1 is a screenshot of the starting point of this design effort:

The six key parameters to be fed into the ClassE tool are quite straightforward. The frequency and supply voltages can be chosen as the designer desires; here 14 MHz and 12 volts. Early in the design process, the other parameters can be guessed. Each of these parameters is now discussed.

The Saturation Voltage is the 'on' resistance of the switching transistor times the current flowing while the transistor is turned on. I knew that I was going to use a MOSFET and that these devices have on resistances of 10s to 100s of milliohms. As can be seen on the screenshot above, the Ipeak current is expected to be around 1.25 amps. Thus, the saturation voltage can be expected to be well below the pessimistic 1 volt I chose.

As expected, the Power parameter can be adjusted at will. I chose 5 watts as a useable power as I generally run QRP.

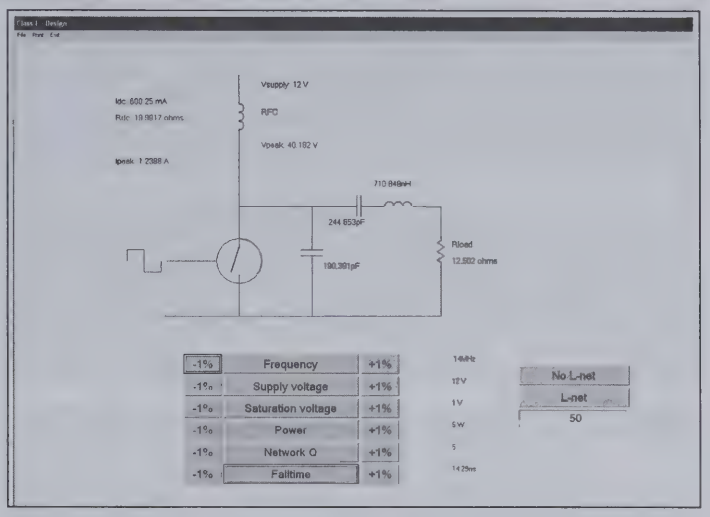


Figure 1—Data entry page for the ClassE software.

Interestingly, changing the power requirements affects only the Rload and the Ipeak values. The Falltime represents the speed of the transistor. I left this parameter alone.

Network Q is the final parameter. This parameter is useful for adjusting the value of the output inductor; larger Q results in larger inductors and smaller capacitors. A Q value of 5 is typical and I left it alone.

Having made a first stab at the power stage of my class E amplifier I decided to go do some simulation. For analog simulation, I use another free tool from Linear Technology called LTSpice. This tool is available to download from www. linear.com. Figure 2 is a screenshot of the circuit entered into LTSpice.

The circuit of Figure 2 may have some unfamiliar symbols, specifically the V1 and V2 voltage sources and the FDS3580 MOSFET transistor. V2 is a simple 12 volt supply voltage. The BSH114 MOSFET is a model provided by Linear Technologies and widely used in switch mode power supplies. It is representative of the transistors I would expect to use in this amplifier. V1 is a little more complicated…

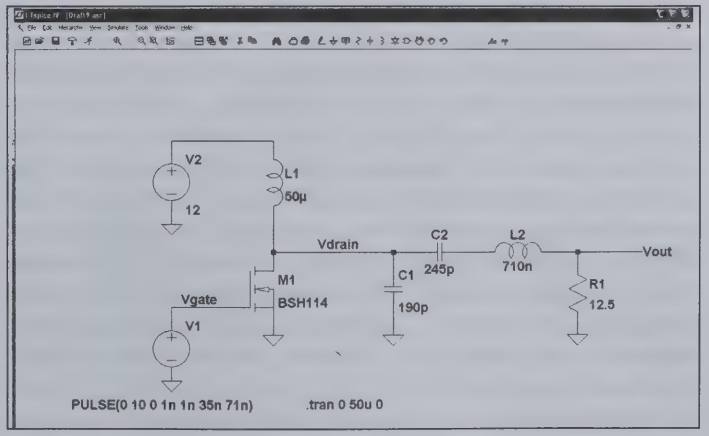


Figure 2—Simulated model of the amplifier using LTSpice.

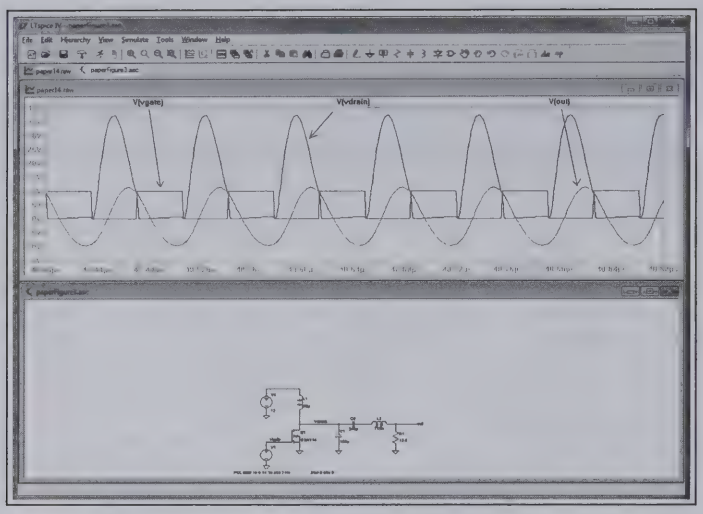


Figure 3—Simulated waveforms in the initial circuit model.

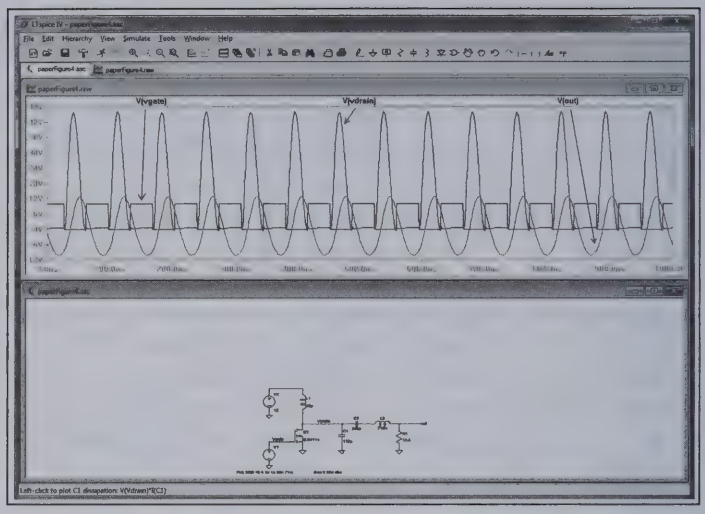


Figure 4—Simulated waveforms taking MOSFET capacitance into account.

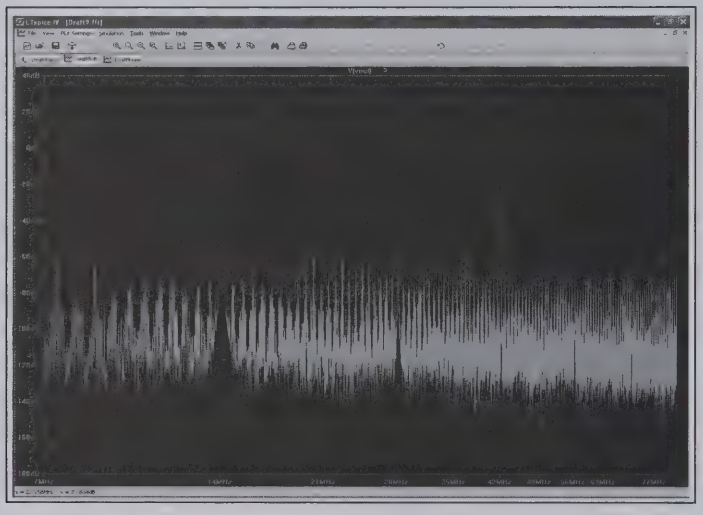


Figure 5—Output spectrum of the modeled amplifier in Figure 4.

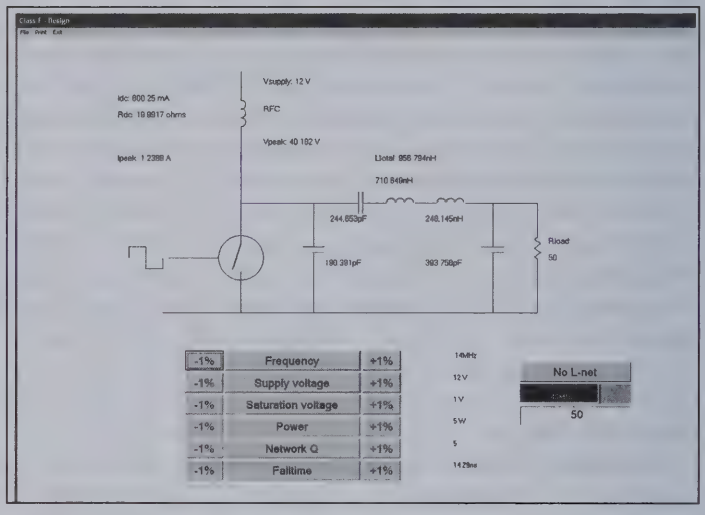


Figure 6—ClassE circuit with L matching network at the amplifier output.

The text under V1 which starts out "PULSE" shows that V1 is not a simple power supply voltage but is, instead, a square wave generator. The key parameters to PULSE are the time the pulse is high (35 nanoseconds here) and the period (71 nanoseconds). The other parameters are the on voltage (10), the off voltage (0) and the rise and fall times of the waveform.

Of course, LTSpice would not be of much use if it could only enter schematics. The real beauty of LTSpice is that it can simulate the circuit as well. Figure 3 is the simulation of the circuit under discussion. The simulation shows the real strength of the class E amplifier. Look closely at what is happening to the V(vdrain) waveform as the V(vgate) signal is going high; the V(vdrain) signal is already going down. Indeed, the goal of the Class E amplifier is to have the V(vdrain) signal be zero just as the V(vgate) signal goes high. Thus, the transistor will have zero voltage whenever it is conducting current; the power dissipated will be (near to) zero.

The waveform of Figure 3 does not have the V(vdrain) signal going to zero just before V(vgate) turns on because we have not yet taken the capacitance of the switching MOSFET into account. This capacitance will result in a lower value for C1. Figure 4 is a simulation with C1 reduced appropriately.

This waveform looks extremely good. A quick calculation is in order. The V(vout) waveform appears to be (largely) sinusoidal so we can compute a rough approximation of the output power: The V(vout) peak is about 12.5 volts so the power out will be Vrms^2 divided by Rload or 12.5*12.5/2/12.5 or 6.25 watts. The current through L1 has an RMS value of about 0.483 amps. Thus, power from the V2 supply is 12*0.483 or 5.8 watts. YES, more power out than in!!! This should raise all sorts of flags. What is wrong? Well, the output power calculation assumed that V(vout) was sinusoidal… is it?

Another great thing about LTSpice is that it can perform an FFT of the waveforms. Figure 5 is the FFT of Vout. Note that the Vout waveform has significant harmonics at 28 MHz (down 17 dB), 42 MHz (down 35 dB), 56 MHz (down 44 dB), 70 MHz (down 48 dB) and higher. Thus, as is expected, the Class E amplifier will need an output filter. Oh… and this explains why power

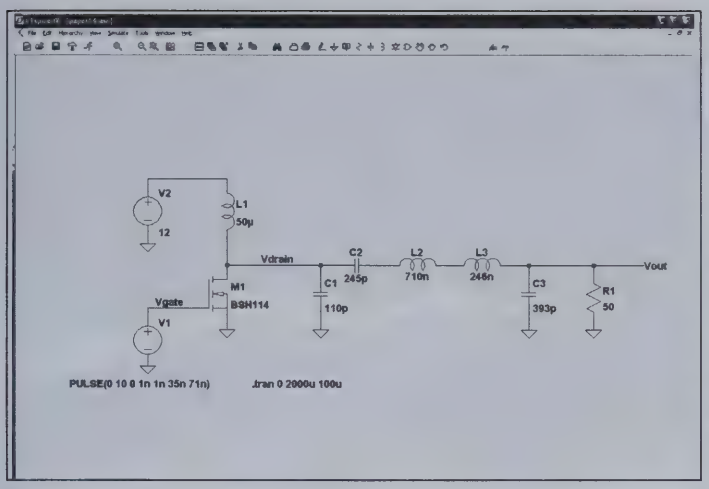


Figure 7—LTSpice simulation for the amplifier in Figure 6.

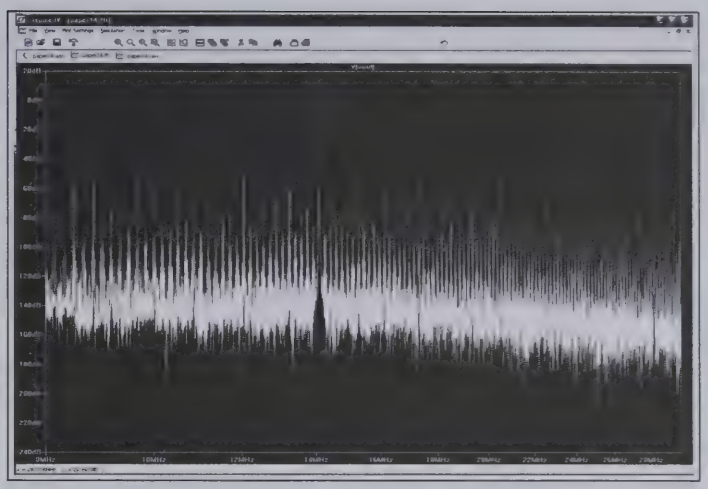


Figure 8—Output spectrum for the amplifier of Figure 6.

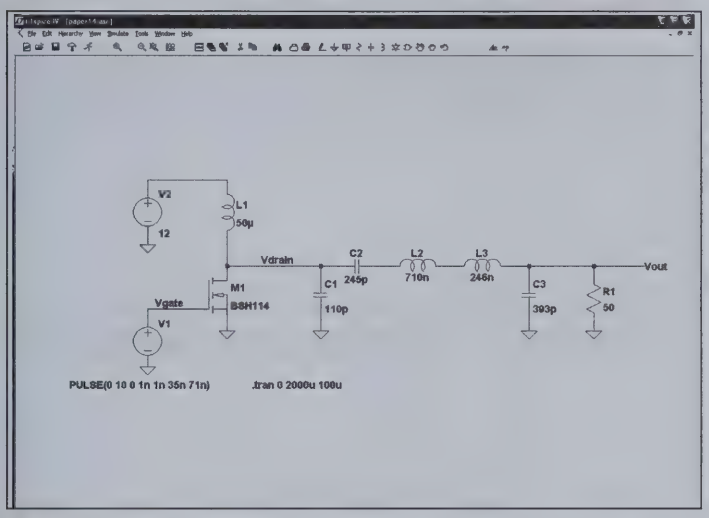


Figure 9—Final design from Elsie showing the output filter.

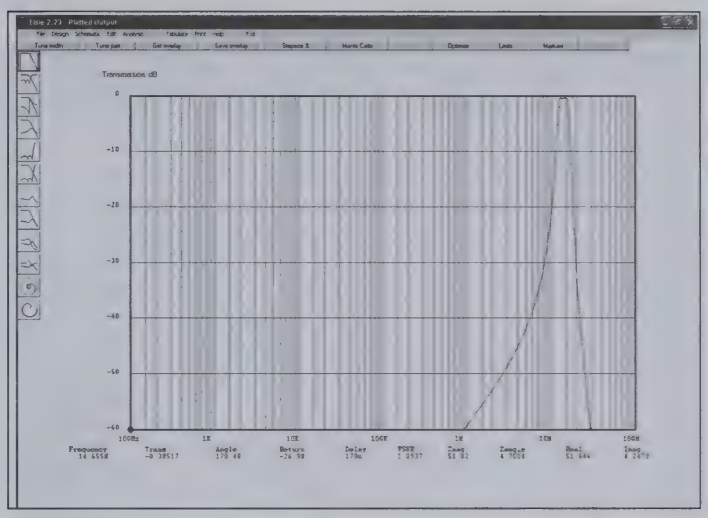


Figure 10—Transfer function of the final output filter.

out appeared larger than power in.

Before proceeding to the output filter, however, there is one issue concerning the power stage of the Class E amplifier. Specifically, Rload in the above design is 12.5 ohms instead of the usual 50 ohms. In the first instantiation of this circuit, I decided that the output filter would have a characteristic impedance of 12.5 ohms and I would merge the L matching network with the last stage of the output filter. This turns out to have been a bad idea. The lower characteristic impedance has the effect of substantially increasing power losses in the inductors of the output filter. Thus, I moved the L matching network to the output of the amplifier and before the output filter. The circuit, shown in Figure 6, is provided by the ClassE tool.

Figure 7 is the resulting LTSpice circuit. And VERY importantly, the output spectrum as shown in Figure 8, now shows greatly reduced harmonic content. The 28 MHz harmonic is now down by 42 dB. The output waveform is much closer to sinusoidal and the output power is now (approximately) 23 volts peak/peak or 23*23/2/50 or 5.3 watts. Much closer to that expected. The difference is probably that the Vsaturated of the transistor is not 1 volt but closer to 0.6 volts. Readjusting the values of the inductors and capacitors should verify this in LTSpice. For this author, that is close enough.

Note now that the output power is about 5.3 watts and the input power was 5.8 watts. This is an efficiency of 5.3/5.8 = 91%, an acceptable value for a Class E amplifier.

Output Filter

For Class E operation, many designers simply design a low pass filter with particular attention to a zero at the second harmonic. I didn't do that. Rather, I chose to design a bandpass filter for 14 MHz. I chose to do a bandpass filter so that I could use the same filter for output and input and not worry about out of band receiver overload.

To design the output filter I employed "Elsie" from the ARRL toolbox. I did extensive playing around with Elsie before settling on the final filter. Elsie is a hugely valuable tool for these explorations. Of key interest to me were the shape of the transfer function and the values of the inductors and capacitors. Figure 9 is the final 'design' page form Elsie. Having decided upon this filter, Elsie is kind enough to plot the transfer function, as shown in Figure 10. As shown, this filter should add another 60 dB of suppression to the second harmonic at 28 MHz. Elsie also can draw the circuit but I won't show that here. Rather, Figure 11 is the

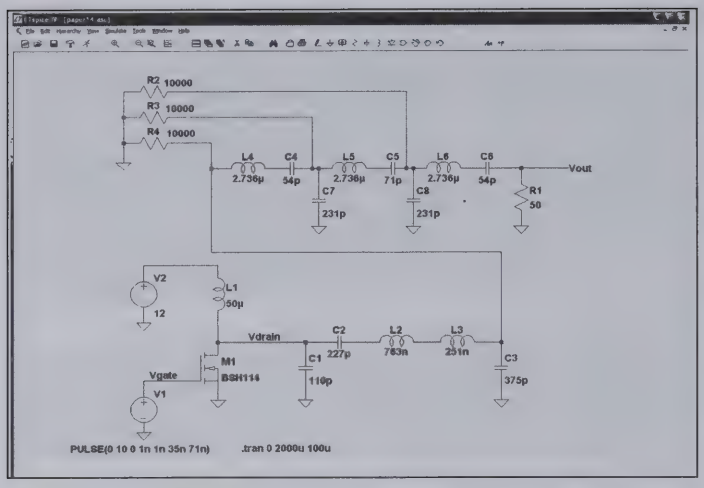


Figure 11—LTSpice circuit; amplifier and final output filter.

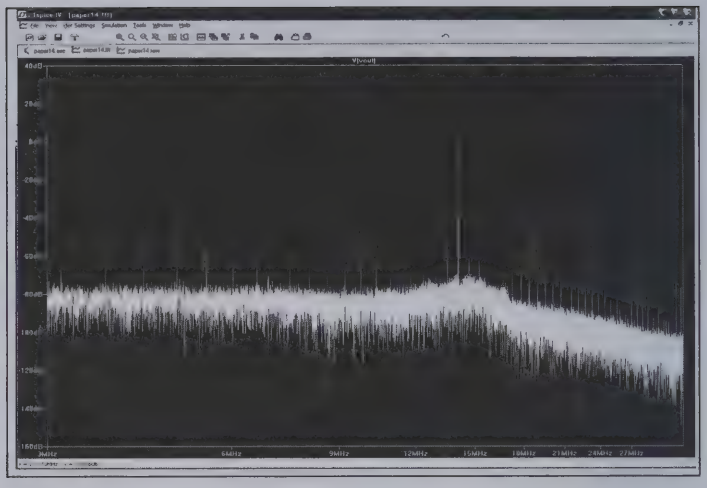


Figure 12—Output FFT of the simulated amplifier and output filter.

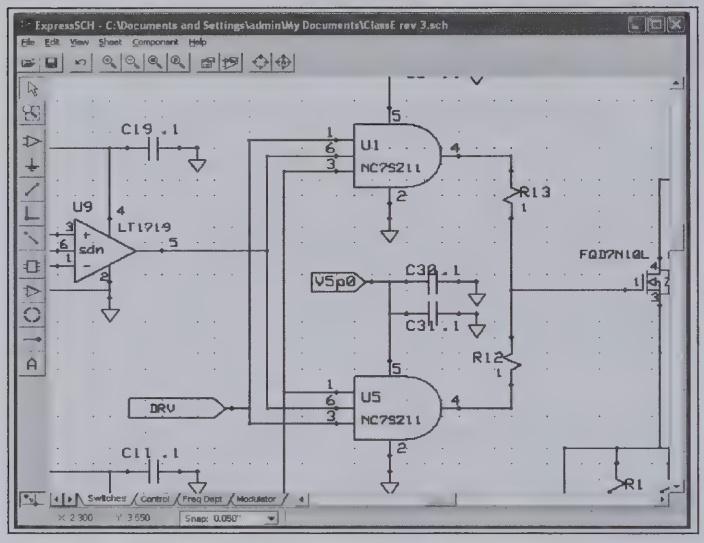


Figure 13—Circuit of the MOSFET driver.

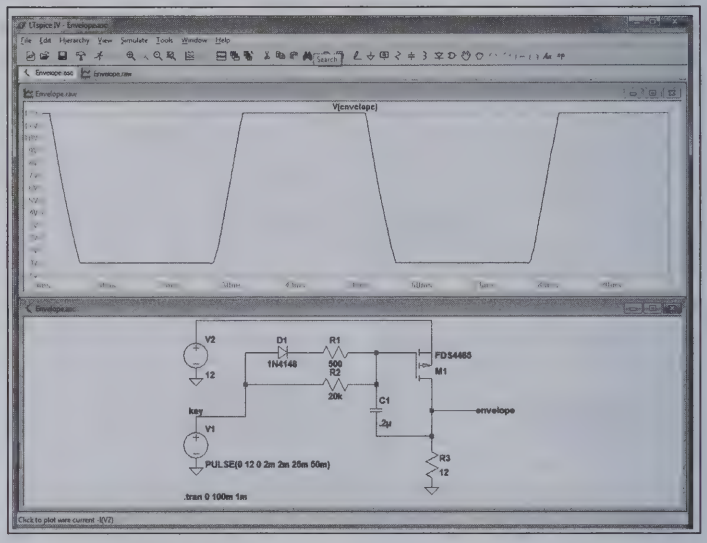


Figure 14—LTSPice simulation showing envelope shaping.

LTSpice circuit. The detail oriented reader will notice the addition of three, 10k resistors. These resistors are needed because LTSpice doesn't work well with undefined voltages on an electrical 'node'. If these resistors were not added then the simulation would run significantly slower.

Figure 12 is the FFT of the output signal. One of the weaknesses of LTSpice is that when computing the FFT it does so over a relatively small subset of time. Even when windowed it can report harmonics which are larger than reality. Still, it can show trends and relative magnitudes. In the above, the 28 MHz harmonic is shown as 60 dB down from the 14 MHz carrier.

Driving the Power Transistor

One of the real niceties of all switching power amplifiers is the simplicity of the drive circuit. Modern MOSFETs can be purchased which have a Vgate on voltage of less than 5 volts. As a result, it is possible to drive the MOSFET gate using standard 5 volt logic components. It is still important to drive the MOSFET gate as hard and fast as possible. Figure 13 is the circuit I used to drive the MOSFET.

Of course, the two NAND gates require digital signals as inputs. There are three inputs to the AND gates shown above. The DRV signal is simply an 'enable' from the SDR processor. The LT1719 is a high speed comparator which converts the incoming analog sine wave (14 MHz here) into a digital square wave. The third signal comes from the protection logic which detects over-current and shuts down the NAND gates when an over-current condition is detected.

Envelope Shaping

In the foregoing circuits, the voltage supply for the power stage is a fixed voltage. However, the polite CW operator tries to reduce key clicks. This is done by 'shaping' the envelope. In this first instance of my power amplifier, I decided to use the traditional shaping approach shown Figure 14.

In Fig. 14, the 'key' signal is driven with 12 volt rail to rail signal from the SDR processor. The values of R1, R2 and C1 are adjusted to fit the operator's desired ramp rates. Slower rates result in less 'key click' noise. Faster rates can improve readability in poor conditions.

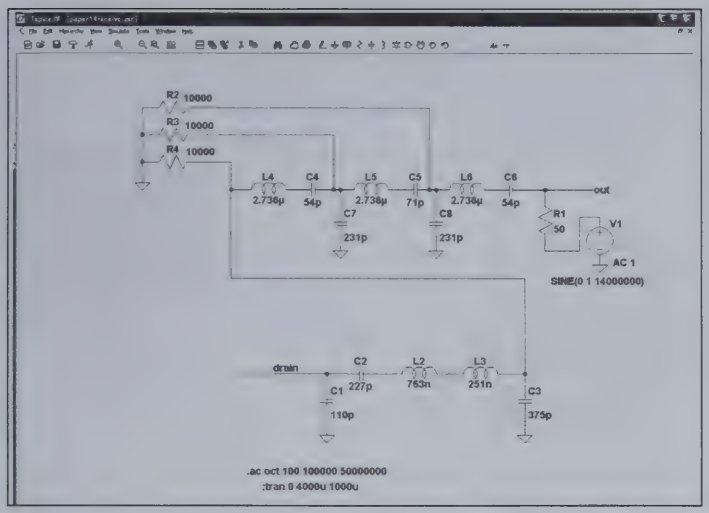


Figure 15—Initial simulation of the amplifier during receive.

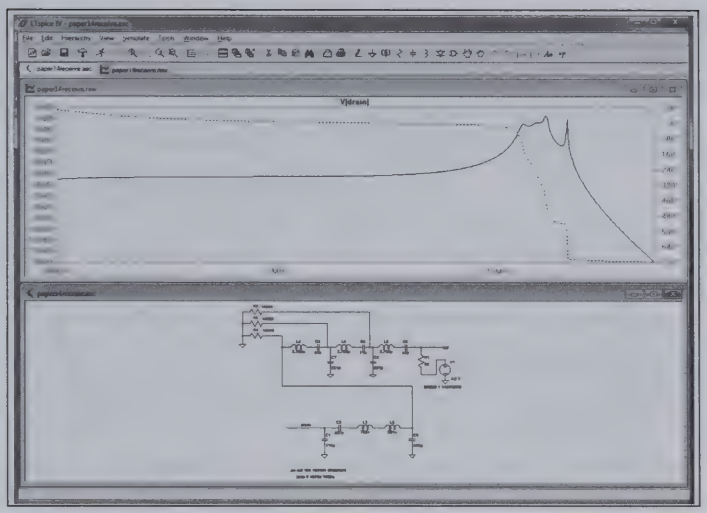


Figure 16—Filter shape for the circuit of Figure 15.

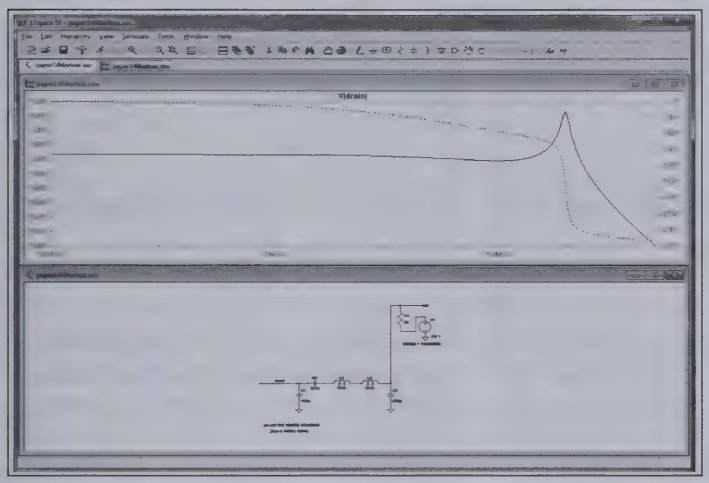


Figure 17—Circuit simulation and transfer function of the matching network only.

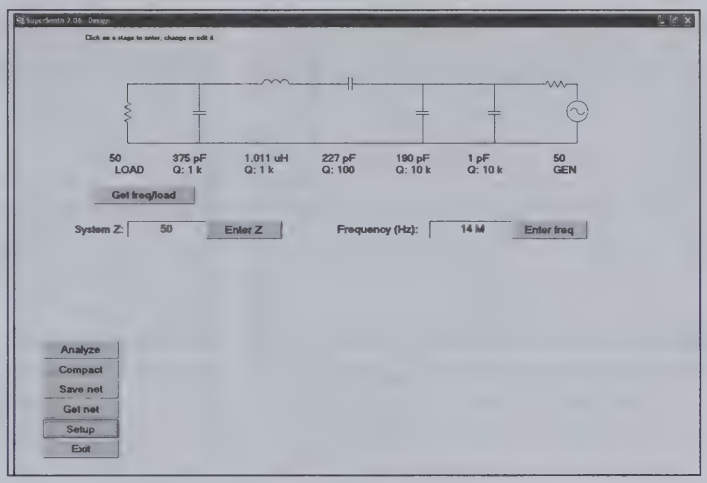


Figure 18—SuperSmith design page for the matching network of Figure 17.

With the addition of an op amp, one can actually modulate the envelope and generate an AM signal. With an 'edge detector' driving the switch FET, one can actually build a linear amplifier using class E as the final stage. There are other ways. The problems involved are brushed over here.

Transmit/Receive Switching

There are many ways to provide transmit/receive switching. In my design, I wanted to use the output bandpass filter as an input filter as well. So, I decided to take the receive signal directly from the MOSFET's drain. It is important to remember that the power transistor and the envelope transistor will be 'off' during reception. Thus, during receive the equivalent circuit is as shown in Figure 15. Note that I have added a voltage source "V1" to the 'out' of the output filter and deleted the MOSFET and envelope voltage sources.

LTSpice has another capability called 'AC' analysis where it can display the filter shape of a circuit. Figure 16 is what LTSpice shows for this circuit. Well, this is pretty ugly, although it really isn't all that bad. Clearly, the problem is that the filter is not terminated properly. Here is where the Smith chart can come in quite handy. Remember that the upper part of the above circuit is just a 50 ohm bandpass filter. Thus, the circuit of Figure 16 can be simplified somewhat to the circuit shown in Figure 17 along with the filter shape. Note the peak at about 20 MHz remains. The goal is to remove this peak and provide a reasonably flat response through 14 MHz.

Moving this circuit to SuperSmith results in the display of Figure 18. Note that I've reversed the circuit and shown the antenna as the load on the left. Also, I've added a capacitor on the right which I'm going to adjust as necessary to get the proper impedance as seen from the GEN side. Clicking the "Analyze" button yields Figure 19.

It is relatively simple to adjust the value of the capacitor on the right to compensate and deliver a 'real' impedance. This has been done in Figure 20 where the 1 pF capacitor has been adjusted to 207 pF. Having adjusted the capacitor value to produce a real value, we can see that this real value is now about 33 ohms. We can put the adjusted capacitor and 33 ohm resistor back into LTSpice just to verify things, and this is shown as Figure 21.

Just for fun, let's look at what happens if we remove the compensating 207 pF capacitor. Figure 22 shows the result. This looks

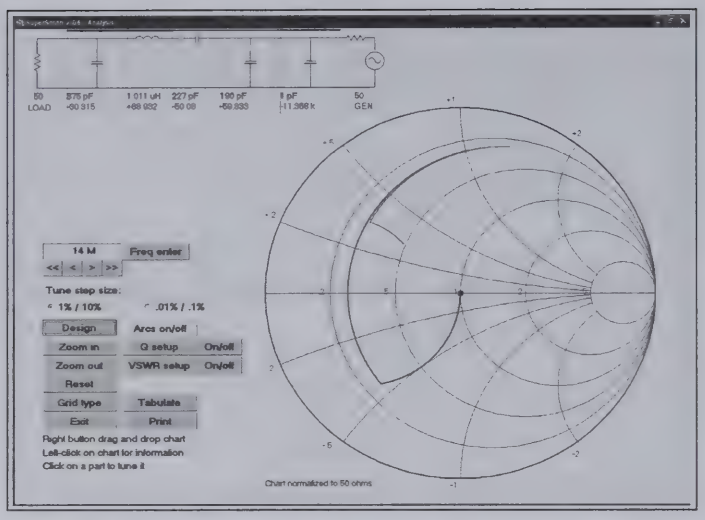


Figure 19—Smith chart analysis of the matching network in Figure 18.

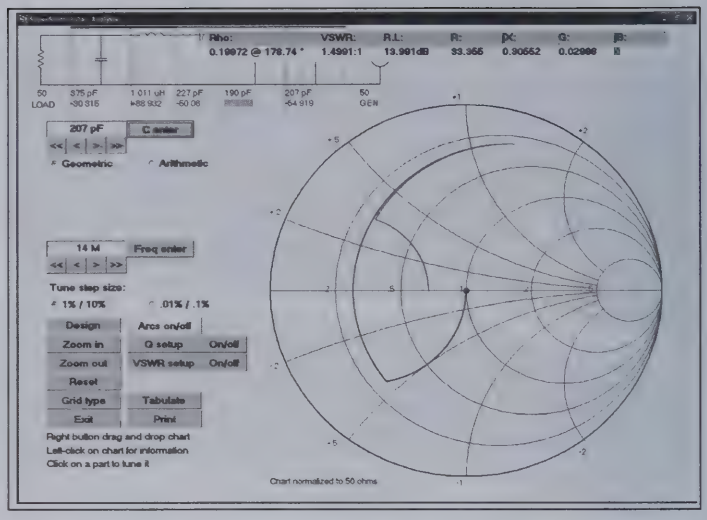


Figure 20—Smith chart analysis after adjusting the right hand capacitor.

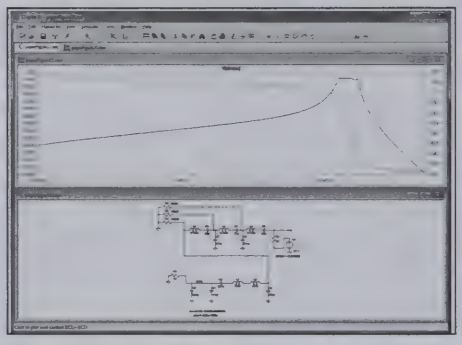


Figure 21—LTSpice simulation after adjusting the right hand capacitor.

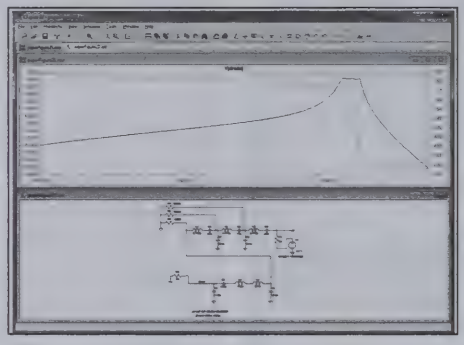


Figure 22—Simulation without the compensating 207 pF capacitor.

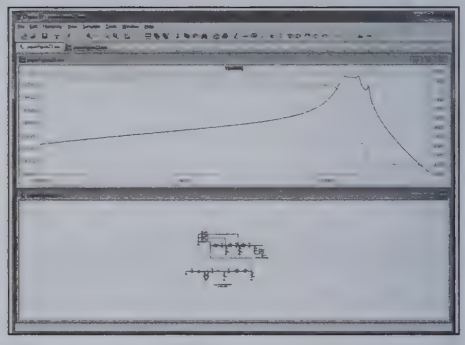


Figure 23—Modifed circuit that includes the 33 ohm resistor only during receive.

pretty darned good (if not better), so let's just leave it out.

The problem now is how to put in the 33 ohm resistor when receiving and how to take it out when not receiving. Figure 23 shows a very common approach. A few notes on the above circuit are appropriate. First, the back/back diodes are generally conducting during transmission. On reception, they don't conduct. Thus, the 25 pF coupling capacitor is in parallel with the MOSFET during transmission and, as a result, C1 has been reduced to compensate. During reception, the 25 pF capacitor has an impedance of roughly X = –500. The inductor cancels this impedance out during receive.

Notice that the peak at around 19 MHz has started to creep back in. If this is a problem, determining the impedance of the diodes and then returning to SuperSmith would help eliminate this peak. I did not think it necessary to take this step. Figure 24 is the more-or-less complete circuit.

Summation

Over the years I've built many circuits designed by other people. Often times I have wondered about the design process itself. How did they make the various decisions? What tools do they use? What compromises do they make along the way? Just how did they get to the end?

In this paper, I have described the step by step process by which I designed my class E, QRP amplifier. It is my hope that the reader has gained an appreciation for the design process and the tools available to help the analysis. These tools allow the budding designer to 'jump in' and start and refine a design with very little experience. Ultimately, when used properly, these tools will let you design, modify and optimize a circuit with confidence. When you actually build it, it will WORK!

●●

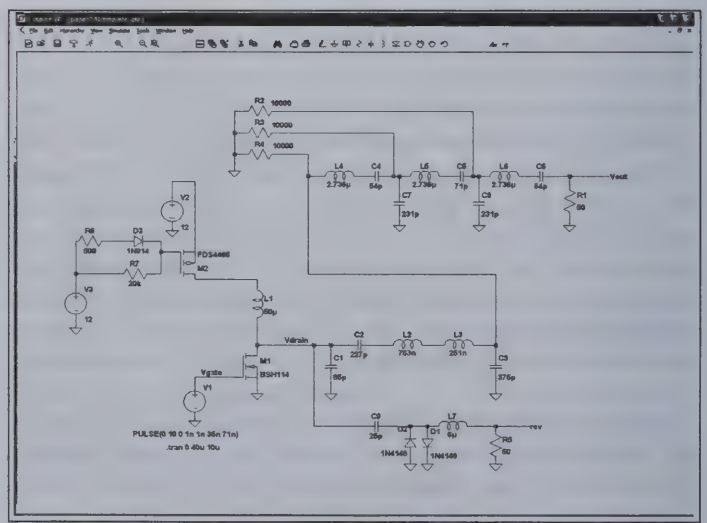


Figure 24—The complete LTSpice circuit of the amplifier.

QRP Contests

Jeff Hetherington—VA3JFF

contest@qrparci.org

Occasionally I receive emails from some of the readers of this column, and participants in the QRP-ARCI Contests. Sometimes these emails contain simply claimed scores and logs, sometimes complaints are made about scoring changes and contest rules, and most exiting for me are the suggestions from our operators about new contests that we can run. With so many contests now on the air, one of the first deciding factors for new contests must be trying to find a free date. QRP-ARCI has maintained approximately one contest per month for the past 10 years and hopes to be able to continue to provide these operating activities for our members. For a new contest to be added to our roster, we must retire one of our existing contests and take over the date associated with it. This is never an easy decision, since invariably the contest being retired is somebody's favourite and will be missed. The first thing that I look for when deciding whether or not to retire a particular contest is the participation rate. It has been printed here before, and we all know from experience, that it isn't fun operating a contest where there are few participants to work.

The graphic to the righ shows the participation numbers for every QRP-ARCI sponsored event since 2000. In that 11 year span, we have offered 17 different contests, with the seven of them having been offered every year. The other ten contests have either been retired or created since 2000. There have been several suggestions for a second SSB event to be added to the schedule and this is something that is being closely monitored. We currently run the Fireside SSB Sprint at the end of January, and we also allow SSB contacts in the End Of Summer VHF Contest, milliWatt Field Day and Top Band Sprints. Watch for something new in the 2012 Contest Calendar. 27 August 2011 will see the first running of the new Welcome to QRP Sprint which has replaced the retired Silent Key Memorial contest on the Calendar. This new event will encourage experienced operators to team with newcomers (less than a year of QRP contesting experience) to allow Elmering in operating technique, CW reception, scoring and general contest operating. There will be categories for experienced operators, single operator newcomers, and newcomers with Elmers. I look forward to seeing you all on the air.

Mark ur Calendars

29 May 2011	**Hootowl Sprint**
25-26 June 2011	**milliWatt Field Day**
10 July 2011	**Summer Homebrew Sprint**
27 August 2011	**Welcome to QRP**
10 to 12 September 2011	**End of Summer VHF Contest**
15-16 October 2011	**Fall QSO Party**

Our contests for this quarter presented some interesting situations. Many new callsigns were seen in the logs and the entry list, and there were some DX certificates issued. Perhaps this is a sign of better propagation to come, and more participation in 2011. The Top Band Sprint saw a new name rise to the top of the charts. Bryan Bydel, W5MX took first place with an impressive score of 78,764 points. Bryan is a non-member and from what I could tell this was his first entry in a QRP-ARCI event. Congrats Bryan, hope to hear you on the air again! Arnold Olean, KØZK started a strong quarter of contesting for him by operating from his brother's QTH with a full size top band antenna. Arnie's total of 47,502 points was good for second place. Brian Campbell, VE3MGY scored 42,900 points from north of the border for third spot, while Doug Thomas, N5ECT, the CW operator at WD5R took fourth place honours with 36,498 points. Todd Fonstad, N9NE rounded out the top five with a very respectable 30,394 points.

Participation was down in the Holiday Spirits Homebrew contest this year, perhaps a result of too much holiday cheer, but Bob Patten, N4BP returned to the top spot as the only entrant to top the 100,000 barrier with 105,264 points. Dana A. "Mike" Michaels finished second with 44,190 points, just staying ahead of John T. Laney III, K4BAI and his total of 42,966 points. The battle for the final two spots in the top five went to Randy Foltz, K7TQ and Arnold Olean, KØZK with 35,174 points and 31,424 points respectively.

Contest	Avg	00	01	02	03	04	05	06	07	08	09	10
Fall QSO Party	105.2	125	94	128	80	123	139	104	86	77	108	93
Spring QSO Party	88.2	111	58	109	89	70	122	72	71	88	98	82
Holiday Spirits Sprint	47.2	58	65	60	27	55	38	41	50	52	46	27
Hootowl Sprint	31.7	42	35	49	40	14	36	30	30	25	24	24
Summer Homebrew Sprint	31.2	47	51	45	43	28	17	15	31	17	29	20
Running of the Bulls	26.3	40	17	22								
Top Band Sprint	24.5		33	27	16	10	24	22	29	21	36	27
Grid Square Sprint	23.8								25	31	13	26
Fireside SSB Sprint	22.5	25	63	33	29	15	9	10	19	17	14	14
Milliwatt Field Day	22.1	11	12	27	17	16	27	22	40	25	22	24
End of Summer PSK-31	18.8	32	23	21		15	3					
Pet Rock	17.5										24	11
SK Memorial Sprint	13.3					19	7	13	15	17	13	9
Summer Daze SSB	8.5	8	9									
VHF Contest	6.0									7	5	6
Newcomers Run	5.0					5						
End of Summer Digital	4.3							5	4	3	5	

QRP ARCI contest activity since 2000.

2010 Top Band Sprint Results

NAME	Call	STATE	POWER	QSOs	Pts	SPC	Mult	Score	RIG & ANTENNA
Bryan Bydel	W5MX	KY	< 5W	93	388	29	7	78764	Orion, Vertical Loop
Arnold Olean	KØZK	ME	< 5W	69	261	26	7	47502	K3, Inverted Vee
Brain Campbell	VE3MGY	ON	< 1W	54	195	22	10	42900	
Doug Thomas	WD5R	AR	< 5W	75	237	22	7	36498	(op: N5ECT)
Todd Fonstad	N9NE	WI	< 5W	49	167	26	7	30394	K3, 176ft doublet and vertical T
Dana "Mike" Michaels	W3TS	PA	< 1W	32	109	18	10	19620	
Charles Moizeau	W2SH	NJ	< 5W	38	139	20	7	19460	Argo V, 180ft CF dipole, Inv L
Bob Nash	VE3KZ	ON	< 5W	34	125	19	7	16625	IC706MKIIG, Inv V
Curt Milton	WB8YYY	MD	< 5W	27	96	18	7	12096	K2, MA160V
Eric McFadden	WD8RIF	OH	< 5W	17	78	13	7	7098	K2, 195ft Inv L
Larry Card	W9CC	IN	< 5W	15	57	14	7	5586	K3, Inv V
Nick Kennedy	WA5BDU	AR	< 5W	15	57	13	7	5187	K3, quarterwave Inv L
Edwin E. "Ted" Albert	AB8FJ	OH	< 5W	13	50	10	7	3500	Argonaut II, End fed wire
Garry S. Nichols	WA1GWH	NY	< 5W	12	48	10	7	3360	TS-430S, Quarterwav against ground system
William G Begley	AE3J/3	DE	< 5W		40	10	7	2800	IC703, 145 ft Inv L
Scott McMullen	W5ESE	TX	< 5W	11	37	8	7	2072	
Robert MacKenzie	VA3RKM	ON	< 5W		38	7	7	1862	K2, 1/4 wave wire
John Collins	KN1H	NH	< 5W	8	31	8	7	1736	IC718
Jim Stafford	W4QO	GA	< 5W	8	31	6	7	1302	
Chuck Guenther	NIØC	MO	< 5W	7	29	6	7	1218	K2, Cushcraft MA160V short vertical
James Rodenkirch	K9JWV	UT	< 5W	9	27	6	7	1134	IC735, Inv L
Will Bowser	VP2MFO		< 5W	6	21	6	7	882	K3, Inv L
Steve Yates	AA5TB	TX	< 5W	5	19	5	7	665	FT897, 1/8 wave inv L
Barry Ives	AI2T	NY	< 1W	5	16	4	10	640	Homebrew, 1/2 80m CF Zepp
Michael Babineau	VE3WMB	ON	< 5W	5	19	4	7	532	Argo V, G5RV used as a Tee vertical
Jim Kells	WA2OQJ	NY	< 5W	3	15	3	7	315	FT817nd, 80m Dipole
Bruce Danielson	W1WQG	CT	< 5W		12	3	7	252	K2, dipole

Arnold Olean, KØZK/1 continued his impressive contesting quarter, and started off 2011 with a bang in the Pet Rock Celebration. Arnie worked DX stations in DL, G, GM, GI, HA, EA6, CT1, HB9 while compiling a contest leading 21,632 points. Dana A. "Mike" Michaels took his second consecutive second place finish with 16,092 points as the top scoring rock-bound participant and Steve Harley, GØFUW was the first DX station of the quarter to crack the top five in a contest with 15,112 points. QRP contest regulars Bob Patten, N4BP with 12,546 points and John T. Laney III, K4BAI with 11,039 points rounded out the top five.

The Fireside SSB Sprint saw our first ever DX station take top prize. Bob Patten was on vacation in Barbados during the contest, and entered as C6AKQ. His total of 25,340 points easily outdistanced all competitors for top spot. John Buchert, AE8M had 10,395 points and Randy Shirbroun, NDØC had 10,353 points in a closely contested battle for second and third place. Bob Cutter, KIØG took fourth place with 5,315 points and Jim Rodenkirch, K9JWV finished in fifth place.

I hope to see some of your in Dayton at FDIM 2011. If you see me, stop by and say hello, it's nice to be able to put a face with the callsigns.

Until next time, keep your power down and your QSO rates up.

—73/72, Jeff, VA3JFF

Top 5 Top Band Sprint

Bryan Bydel, W5MX	78,764 pts
Arnold Olean, KØZK	47,502 pts
Brian Campbell, VE3MGY	42,900 pts
Doug Thomas, WD5R (op: N5ECT)	36,498 pts
Todd Fonstad, N9NE	30,394 pts

Top Band Sprint Soapbox

Operated from QTH of K1WHS: My brother has a full size 160 inverted vee at 90 feet. Great to operate with a super antenna for once! **—KØZK**

Another fun time on the radio. It's always fun to spook the heavy metal gang with our small signals that they think are DX, but they never seem to stop by to give us a 419 999W report. **—WB8YYY**

I operated portable from a salt marsh on the Delaware River at Port Penn Delaware. **—AE3J/3**

I hoped to increase last year's score but that never happened. While I did work 5 more stations than I did last year I worked 3 less ARCI members and 1 less SPC which dropped my score 2,000 points lower than last year. Hoever it was still lots of fun and the band was S0 all evening so no complaints from here. **—VE3MGY**

Noisy with deep QSB tonight. But glad to hear so many on. I counted 5 ops from Contest Club Ontario. Any other contest clubs want to take us on? **—VA3RKM**

6 contacts only due to QRN. I heard a few others but not well enough for a QSO. **—VP2MFO**

My first 160m contest. I participated only 1.5 hours. Used half of my 80m Zepp as an antenna. Just finished building a 1 watt 160m transmitter from scratch. I was impressed by the number of participants, but many could not copy me. I hope to put up a better antenna for future contests. **— AI2T**

Boy do I need an RX antenna. 160m was very noisy so I decided 5 QSOs was enough. **—VE3WMB**

This was my 1st attempt in my 27 years

2010 Holiday Spirits Homebrew Sprint

NAME	Call	STATE	BANDS	POWER	QSOs	PTS	SPC	MULT	BONUS	SCORE	RIG & ANTENNA
Bob Patten	N4BP	FL	ALL	< 5W	62	256	42	7	30000	105264	K3, A4S, Sewper Armadillo
Dana "Mike" Michaels	W3TS	PA	ALL	< 1W	22	101	19	10	25000	44190	K2, Tee, dipoles, yagis
John T. Laney III	K4BAI	GA	ALL	< 5W	45	198	31	7	0	42966	FT1000MP, TH6, dipole, vee
Randy Foltz	K7TQ	ID	ALL	< 5W	31	131	22	7	15000	35174	K3, Force 12C4SXL
Arnold Olean	KØZK/1	ME	ALL	< 5W	21	96	17	7	20000	31424	K2, Endfed Wire
Barry Ives	AI2T	NY	ALL	< 5W	19	89	16	7	15000	24968	K1, Yagi and CF Zepp
Larry Maso	NU4B	TN	ALL	< 5W	12	54	11	7	20000	24158	K2, Carolina Windom Short 80
John Buchert	AE8M	OH	20/40	< 5W	20	88	14	7	15000	23624	K1, Buddipole
Joe Vrabel	KD2JC	NJ	ALL	< 5W	17	82	14	7	15000	23036	K2, 40m loop, triband yagi
Don Minkoff	NK6A	CA	ALL	< 5W	16	74	14	7	15000	22252	K1, K3, Force 12C4
Curt Hulett	KB5JO	TX	ALL	< 1W		47	9	10	15000	19230	K1, 88ft doublet
John Collins	KN1H	NH	ALL	< 1W	9	42	8	10	15000	18360	Homebrew
Andrew Measday	WA5RML	TX	ALL	< 5W		79	15	7	10000	18295	K1, FT817
Philip Schweitzer	KØCD	WI	20	< 1W	19	83	14	10	5000	16620	SW20, Bobtail Curtain
Donald C. Younger	W2JEK	NJ	ALL	< 5W	6	30	5	7	15000	16050	OHR-500
Scott McMullen	W5ESE	TX	ALL	< 5W	6	30	4	7	15000	15840	ATS3
Robert MacKenzie	VA3RKM	ON	20/40	< 5W	11	52	10	7	10000	13640	K2, Verticals
Bob Cutter	KIØG	CO	20	< 5W	9	42	9	7	10000	12646	KX1, Longwire
Bruce Danielson	W1WQG	CT	20/40	< 5W		15	2	7	10000	10210	K2,
Brion Jorgensen	VE3FUJ	ON	20/40	< 5W	3	9	3	7	10000	10189	K2, Wires
Phil Sauvey	KL8DX	AK	High	< 5W	16	71	12	7	0	5964	IC703, 4 element tribander
Cam Castillo	HP1AC		20	< 5W	13	62	12	7	0	5208	IC706MKIIG, dipole
Steve Ray	K4JPN	GA	80	< 5W	1	5	1	7	5000	5035	K2, 80m CF Zepp
Frank Shapiro	NM5S	NM	20	< 5W	13	62	11	7	0	4774	Hex Antenna
Larry Mergen	KØLWV	MO	20	< 5W	9	39	8	7	0	2184	IC718, 40m vee, 20m wire GP
Will Bowser	K9FO	IL	80	< 5W	2	10	2	7	0	140	Orion, Longwire
Brock Thomsen	W6GMT	MN	40	> 5W	6	18	6	1	0	108	IC703, 40m vee

as a Ham to do any operating on 160, so no matter what I scored it was a new experience for me! Terrible line noise here, a solid S8/9 the entire contest made for tough listening and led to way too many "ear" breaks (sometimes for an hour at a time!) I ended up with 3 measly contacts but I am grateful for all 3 of them! All in all I didn't think for my 1st time out I did too bad, especially seeing as my, in name only, 80 meter dipole is all I have for an antenna ... Had a great time and will be back for more. **—WA2OQJ**

Very bad QSB at this QTH. **—W1WQG**

Top 5 Holiday Spirits HB Sprint

Bob Patten, N4BP	105,264 pts
'Mike' Michaels, W3TS	44,190 pts
John T. Laney III, K4BAI	42,966 pts
Randy Foltz, K7TQ	35,174 pts
Arnold Olean, KØZK	31,424 pts

Holiday Spirits Homebrew Sprint Soapbox

Two QSOs on 15m—10 miles (W4OV) and 4000 miles (KL8DX). Worked KL8DX on two bands. Participation sadly lacking. Knocked off an hour early when noise became unbearable. **—N4BP**

Had some time before a hoilday party so jumped in for some fun, to bad activity was so low. **—W3TS**

A great 1st hour, fair 2nd, and tough 3rd and 4th. Especially good QSOs were getting called by KL8DX and HP1AC. Haven't worked Cam in a long time. Tried 15 and 40, but 20 was the place to be. **— K7TQ**

Portable from Kennebunkport, ME. Fun having HC4 and HP1 call me during QRP event. **—KØZK/1**

Too many distractions at home. Band could have been better. Thanks to all that worked me. **—KD2JC**

Elecraft K1 @ 5 watts to Buddipole antenna on 20M & 15M—operating from the shores of Lake Arlington; Last 2 QSOs were on 40M from home—FT-817 to 40M dipole; Was initially going to operate from home QTH, but RF interference killed that idea. So grabbed the K1 and Buddipole and headed out to Lake Arlington. As usual, 20M was the "money" band. Nice to work old QRP friends, including Randy (K7TQ), Bob (N4BP), and John (K4BAI, twice!). However, the highpoint of the contest was working Philip (KL8DX) in Alaska! That is so rare for me here in North Texas! I don't know if he was using his Buddipole, but if so, that would be a remarkable Buddipole to Buddipole QRP QSO! **—WA5RML**

Deep QSB on 20m, but not noisy. Did not hear many ops in the time I was on, but worked a couple of new calls. **—VA3RKM**

My smallest score ever! I worked the Stew Perry contest and slept through almost all of the ARCI Holiday. Just woke up for two QSOs. Hope to do better next time. **—K9FO**

Top 5 Pet Rock Celebration

Arnold Olean, KØZK/1	21,632 pts
'Mike' Michaels, W3TS	16,092 pts
Steve Hartley, GØFUW	15,112 pts
Bob Patten, N4BP	12,546 pts
John T. Laney III, K4BAI	11,039 pts

Pet Rock Celebration Soapbox

End-fed wire antenna, with the far half blown down in a blizzard and on the ground buried in the snow. Many Europeans were worekd DL, G, GM, GI,

2011 Pet Rock Celebration

NAME	CALL	STATE	BANDS	POWER	QSOs	PTS	SPC	MULT	BONUS	SCORE	RIG & ANTENNA
Arnold Olean	KØZK/1	ME	15/20	< 5W	9	108	22	7	5000	21632	K3, End fed wire
Dana "Mike" Michaels	W3TS	PA	ALL	< 5W		26	6	7	15000	16092	Homebrew
Steve Hartley	GØFUW		20/40	< 5W	4	8	2	7	15000	15112	Homebrew, Norcal Doublet
Bob Patten	N4BP	FL	20	< 5W	20	77	14	7	5000	12546	SST-20, A4S
John T. Laney III	K4BAI	GA	ALL	< 5W	25	83	19	7	0	11039	FT1000MP, dipole, inv vee, zepp
Scott McMullen	W5ESE	TX	20/40	<500mW	4	20	3	15	10000	10900	Rockmites, End fed wire
Tim Colbert	K3HX	PA	20/40	< 5W	26	90	17	7	0	10710	Orion I, Dipoles
Houston QRP Club	N5EM	TX	20	< 5W	4	20	4	7	10000	10560	SST
Russell Hulett	KB5JO	TX	20/40	< 1W	2	10	2	10	10000	10200	40-9er, Himite 88ft doublet
Edwin E. "Ted" Albert	AB8FJ	OH	20/40	< 5W	5	25	5	7	8000	8875	49er, Universal 20, Random Wire
Randy B. Foltz	K7TQ	ID	20	< 5W	13	53	10	7	5000	8710	SST-20, Norcal miniboots, C4SXL
Robert MacKenzie	VA3RKM	ON	20	< 5W		38	8	7	5000	7128	K1, Vertical
Dave Hottell	AB9CA	AL	40	< 250mW	8	22	4	20	5000	6760	Tuna Tin 2, Sudden Storm, dipole
Paul Kirley	W8TM	OH	20/40	< 5W	18	57	15	7	0	5985	K3, 40m inv vee
Ray Wright	K8DRT	MI	40	< 500mW	1	5	1	15	5000	5075	Rockmite, OCF dipole
Wayne Nickel	W5WO	TX	40	< 1W	1	5	1	10	5000	5050	Univ QRP Xmtr, MRX-40, dipole
Donald C. Younger	W2JEK	NJ	20	< 5W	1	5	1	7	5000	5035	Two-fer, Roof mounted GP
Hank Greeb	N8XX	MI	40	< 1W	1	5	1	10	0	50	Drake TR-5, Inv Vee

HA, EA6, CT1, HB9 so I'm not complaining. **—KØZK/1**

It was a ruff contest this time, VFO ops need to use their RITs and look a little for the Rock Bound stations calling them. Maybe a revision to the rules is needed. I have a few QRP frequency crystals but most were busy with VFO controlled "Big Gun" QRPers calling endless CQs and not tuning for XTAL controlled stations that were answering. Maybe the VFO controlled stations should not be allowed to CQ, but just answer XTAL controlled stations or maybe a rule where the VFO ops must move 1 kHz after every CQ. **—W3TS**

20m was a struggle due to very limited VXO range and band closed after first hour. 40m was full of German QRP contesters so could not get through to other countries, had "QRZ?" from Austria and Italy but not full QSO exchange. Started raining with 30 mins left to go but no /P shelter so had to abandon the station but better score than last year. **—GØFUW**

Very confusing with SKN going at the same time. **—W5ESE**

Low QRN, Great Fun! **—K3HX**

Beautiful day, though windy and chilly. New locatoin for HQRP and a keeper. Three stations set-up for different bands, QRP Plus, SST and vintage HQ-105TR and Ameco AC-1 on batteries. **—N5EM**

Really great to work K3HX using my Norcal 49er on a 9 volt battery for 100 mw! **—AB8FJ**

Went portable in Britannia park on the foggy Ottawa River, surrounded by snow and squirrels. Condx were excellent on 20m but few ops on the air. Worked EA6UN with the fishing-pole vertical but forgot to ask his power. The annual new year's polar bear dip in the river was just getting underway as I left. I passed it up; I was already cold enough! **—VA3RKM**

It was a bit slow with 190 mW, but what do you expect on 40m in the daytime? Was fun nonetheless. Really wanted to work W8TM at the end. He had called about 1515z but there was too much QRM for my little DC receiver and I was not able to pull out his number. heard him work someone near the end of the test and got it then. He was calling about (maybe) 400 Hz above my rock bound TX but was not tun-

2011 Fireside SSB Sprint

NAME	Call	STATE	BANDS	POWER	QSOs	PTS	SPC	Mult	Bonus	SCORE	RIG & ANTENNA
Bob Patten	C6AKQ		20	< 10W	50	181	20	7	0	25340	K3, Dipole
John Buchert	AE8M	OH	20/40	< 10W	21	99	15	7	0	10395	K3, 20m beam, 40m dipole
Randy Shirbroun	NDØC	MN	ALL	< 5W	24	87	17	7	0	10353	Argonaut 509, triband yagi, inv vee
Bob Cutter	KIØG	TX	20	< 5W	3	15	3	7	5000	5315	Longwire
Jim Rodenkirch	K9JWV	UT	20	< 10W	14	61	11	7	0	4697	
James Crawford	K5YC	NM	20	< 5W	14	52	9	7	0	3276	IC706MKIIG, 5 element beam
Paul Blum	K9ARF	WI	ALL	< 5W	8	56	8	7	0	3136	IQ-Pro/T2/R2a, 80m Horiz Loop
Rob May	K6JSS/5	TX	20	< 5W		48	9	7	0	3024	K3, TH-3JR
Scott McMullen	W5ESE	TX	ALL	< 5W	10	42	9	7	0	2646	Omni 6, 300ft horizontal loop
Robert MacKenzie	VA3RKM	ON	ALL	< 5W		40	8	7	0	2240	K2, Verticals, Wires
John T. Laney III	K4BAI	GA	40/80	< 5W	8	25	8	7	0	1400	FT1000MP, zepp, dipole, vee
John Parnell	K7HV	WA	20	< 5W	6	30	6	7	0	1260	K2, G5RV
Kevin Anderson	K9IUA	IA	40	< 5W	4	17	4	7	0	476	Argo 556
T.J. "Skip" Arey	N2EI	NJ	20/40	< 10W	4	17	4	7	0	476	K2, Dipole
Jim Huff	KD5KJ	AR	20/40	< 5W	3	15	3	7	0	315	doublet
Steve W. Glenette	WB7OCV	NY	20	< 5W	3	15	3	7	0	315	SGC SG-2020, Hustler 6BTV
Tim Colbert	K3HX	PA	20	< 5W	2	10	2	7	0	140	
Jim Francoeur	KC1FB	CT	20	< 5W	1	5	1	7	0	35	FT-7

ing around looking for us! I called and called and called but to no avail. Oh, well, maybe next year! I tuned around looking for other rock bound rigs and picked up one, W4QO, that way. BTW, nice signal from your rig! Looking forward to another round next year! Maybe I can get onto 20 by then. **—AB9CA**

Only operated less than an hour. Had some fun though. What a great time. It's nice to know that the little rig you built works FB. I will definitely do this again when you have tem. QRP is something I grew up with in my family and enjoy it. I will endeavor to keep up the practice of QRP CW. **—K8DRT**

I had somewhat limited time and was bothered by QRO ragchewers around the QRP frequencies. Next time I hope to have more rocks and be on more bands. **—W5WO**

Got on for last 20 minutes, heard W8TM @ about 7041 kHz at 99 over S-9 on 40 meters. Heard some more ragchews around 7039 to 7040, but no one calling CQ test. Called a couple "CQ Pet Rock", tuned with RIT on rig, but nil. Went to 20, heard AE5X working WA3WSJ/PM but he didn't respond after they were finished. Ran out of time. **—N8XX**

Top 5 Fireside SSB Sprint

Bob Patten, C6AKQ	25,340 pts
John Buchert, AE8M	10,395 pts
Randy Shirbroun, NDØC	10,353 pts
Bob Cutter, KIØG	5,315 pts
Jim Rodenkirch, K9JWV	4,697 pts

Fireside SSB Sprint Soapbox

Burned out from the CQ 160m contest and dealing with a bad headache. Could only hang in for about an hour. **—C6AKQ**

Only operated for two hours - very slow going. **—NDØC**

No 10 or 15 meters prop. Slow on contacts; band conditions not very good. **—K5YC**

My first QRP Contest **—K9ARF** (op: NV5E - K6JSS/5)

Not many ops were on the 20m band, and only locals on the others. The suggested 40m QRP frequency was overrrun with BC stations and should be changed. Good to hear voices to put with CW fists. **—VA3RKM**

I had a good time, but twas not easy here in the NW with the guy in AL running 500 W and perched on 14.285 most of the time. Some FB operators out there with great ears. **—K7HV**

Got on for a few minutes to help out by handing out points. **—K9IUA**

China Radio Inernational was camped on 7.285 for most of the contest. **—N2EI**

Besides some equipment problems, I think it was rotten propagation in WNY! **—WB7OCV**

Only had a few minutes to play this year, and the band was not very good. Called CQ on and off with no takers. **—KC1FB** ●●

Contest Announcements

2011 QRP-ARCI Summer Homebrew Sprint

Date/Time:
2000Z to 2359Z on 10 July 2011

Mode:
HF CW only

Exchange:
Members send: RST, State/Province/Country, ARCI member number
Non-Members send: RST, State/Province/Country, Power Out

QSO Points:
Member = 5 points
Non-Member, Different Continent = 4 points
Non-Member, Same Continent = 2 points

Multiplier:
SPC (State/Province/Country) total for all bands. The same station may be worked on multiple bands for QSO points and SPC credit.

Power Multiplier:
>5 watts = x1
>1 - 5 watts = x7
>250 mW - 1 watt = x10
>55 mW - 250 mW = x15
<55 mW = x20

Suggested Frequencies:

160m	1810 kHz
80m	3560 kHz
40m	7030 kHz (also 7040 kHz for rock bound participants)
20m	14060 kHz
15m	21060 kHz
10m	28060 kHz

Score:
Final Score = Points (total for all bands) x SPCs (total for all bands) x Power Multiplier + Bonus Points.

Bonus Points:
1) For homebrew gear (per band) add 2,000 points for using HB transmitter; add 3,000 points for using HB receiver; or add 5,000 points for using HB transceiver. Definition of "homebrew" is any equipment build and soldered by you, whether scratch-built or from a kit. Plug and Play modular style kits are not eligible for the bonus.
2) If you are operating PORTABLE using battery power AND a temporary antenna, add 5000 points to your final score. (You can NOT be at your shack operating from battery power using your home station antenna to qualify for this bonus.) This is to help level the playing field for contesters who operate from the field.

Categories:
Entry may be All-Band, Single Band, High Bands (10m-15m-20m) or Low Bands (40m-80m-160m)

Deadline:
Entries must be postmarked on or before 24 July 2011.

Certificates:
Will be awarded to the top scoring entrant in each category, plus 2nd and 3rd place if entries are sufficient in a category.

2011 Welcome to QRP, Sponsored by QRP-ARCI

Date/Time:
1500Z to 1800Z on 27 August 2011.

How to Participate:
This Sprint is designed to encourage operators that are new to the world of QRP Contests to team up with one of the many experienced operators (Elmers) among us. This can be done by working at the Elmer's station, having the Elmer come to your station, or even meet-

ing up for a portable field operation during the contest. The Elmer may assist the new operator in any way, helping to log, teaching technique, working to improve CW reception skills and offering any advice necessary.

Mode:

HF CW only.

Exchange:

Members send: RST, State/Province/Country, ARCI member number
Non-Members send: RST, State/Province/Country, Power Out

QSO Points:

Member = 5 points
Non-Member, Different Continent = 4 points
Non-Member, Same Continent = 2 points

Multiplier:

SPC (State/Province/Country) total for all bands. The same station may be worked on multiple bands for QSO points and SPC credit.

Power Multiplier:

>5 watts = x1
>1 - 5 watts = x7
>500 mW - 1 watt = x10
>200 mW - 500 mW = x15
>55 mW - 200 mW = x20
<55 mW = x25

Suggested Frequencies:

80m	3560 kHz
40m	7030 kHz (listen on the old 7040 kHz frequency as well)
20m	14060 kHz
15m	21060 kHz
10m	28060 kHz

Bonus Points:

If you are operating PORTABLE using battery power AND a temporary antenna, add 5000 points to your final score. (You can NOT be at your shack operating from battery power using your home station antenna to qualify for this bonus.) This is to help level the playing field for contesters who operate from the field.

Score:

Final Score = Points (total for all bands) x Grid Squares (total for all bands) x Power Multiplier + Bonus Points

Categories:

Entries may be Newcomer Single Operator, or Newcomer Elmer Assisted. Newcomer will be defined as less than one year of QRP Contest Operating Experience. Entries may also be Experienced Single Operator for operators with more than one year of QRP Contest Operating Experience. Entry may be All-Band, Single Band, High Bands (10m-15m-20m) or Low Bands (40m-80m)

Deadline:

Entries must be postmarked on or before 10 September 2011.

Certificates:

Will be awarded to the top scoring entrant in each category and Certificates will be awarded to Operator and Elmer in the Elmer Assisted Category. There will also be additional Certificates of Merit for new operators that work 1, 10, 25, and 50 members during the contest. Certificates may be awarded for 2nd and 3rd place if entries are sufficient in a category.

2011 QRP-ARCI End of Summer VHF Contest

Date/Time:

1800Z on September 10, 2010 through 0300Z on September 12, 2010.

Bands:

All bands over 50MHz as outlined in the ARRL September VHF Sweepstakes Rules

Mode:

Any legal mode.

Exchange:

4 digit Maidenhead Grid Square Locator as outlined in the ARRL VHF Sweepstakes Rules

Entry Categories:

Single Operator; Rover (up to two operators allowable)

QSO Points:

1 point for 50 MHz and 144 MHz QSOs
2 points for 222 MHz and 432 MHz QSOs
4 points for 902 MHz and 1296 MHz QSOs
8 points for 2.3 GHz or higher QSOs

Special Scoring for Rovers only:

The final score consists of the total number of QSO points from all bands multiplied by the sum of unique multipliers (grid squares) worked per band (regardless of which grid square they were made in) plus one additional multiplier for every grid square from which they successfully completed a contact. QSOs utilizing repeaters of any kind are prohibited. QSOs on the National Simplex Frequency 146.52 MHz are prohibited.

Power Multiplier:

>10 watts = x1
>5-10 watts = x4
>1-5 watts = x7
>250 mW - 1W = x10
>55 mW - 250 mW = x15
55 mW or less = x20

Score:

Points (total for all bands) x Maidenhead Grid Squares (total worked on each band) x Power Multiplier.

Bonus Points: (none)

Best reason to participate:

A fun mixed-mode QRP VHF contest.

Deadline:

Entries must be postmarked on or before 26 September 2011.

For all Contests — Log Submission and Publication of Results

Email Submission—Submit Logs in plain text format along with a summary stating your Callsign, Entry Category, Actual Power and Station Description along with score calculation to contest@qrparci.org

Snail mail Submission—Submit Logs along with a summary stating your Callsign, Entry Category, Actual Power and Station Description, along with score calculation to:

QRP-ARCI (Name of Contest)
c/o Jeff Hetherington, VA3JFF
139 Elizabeth St. W.
Welland, Ontario
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Will be published in *QRP Quarterly* and shown on the QRP-ARCI website, www.qrparci.org

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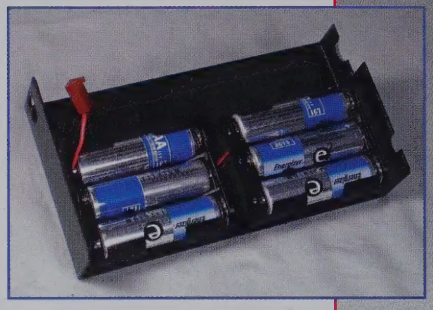

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